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SEPTEMBER, 1958

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MNIUM ANDREWSIANUM, A NEW SUBARCTIC AND ARCTIC MOSS

WILLIAM CAMPBELL STEERE[1]

During the summer of 1948 I found a diminutive *Mnium*, quite unfamiliar to me, to be common and abundant in tundra areas at the east and southeast ends of Great Bear Lake and at Coppermine, at the west end of Coronation Gulf, in the Northwest Territories of Canada. On first sight, because of the small size of the plants and their habit of growing in wet depressions, frost cracks and other places with reduced light intensity, I assumed this species to be only a juvenile form of some familiar species of *Mnium* or of *Cinclidium*. However, on further field work, colonies of antheridial plants, rather different from those of *M. punctatum* or of *M. pseudopunctatum*, were discovered, so that the species proposed here was recognized in the field as a distinct and probably new species.

Although I applied the herbarium name *Mnium andrewsianum* to this moss nearly ten years ago, I did not describe it formally for several reasons. In the first place, in the zone of reduced, bract-like leaves that separates them from the fully developed vegetative leaves below, the antheridial inflorescences resemble so closely those of *Mnium hymenophyllum* [which Kjeld Holmen

[1] N. Y. Botanical Garden, Bronx Park, Fordham Branch P. O., New York, N. Y. Grateful acknowledgment is made here for generous support of my research, both in the field and in the laboratory, by several agencies: during the summer of 1948 in subarctic and arctic Canada, by the Office of Naval Research; during the summer of 1949 in central Alaska, by the Alaska Terrain and Permafrost Section of the U. S. Geological Survey; and during the summers of 1951, 1952 and 1953 in arctic Alaska, by the Office of Naval Research, the Arctic Institute of North America, and the National Science Foundation. A continuing grant from the National Science Foundation (G-2126) has made possible the completion of this paper.

(1957) has recently set apart in a new genus, *Cyrtomnium*] and of *Cinclidium arcticum*, that the generic position of the species was not convincingly clear to me, especially in the absence of fruiting material until relatively recently. In the second place, so many new species of *Mnium* and of *Cinclidium* have been described from Siberia and eastern Asia (Kabiersch, 1936) that it seemed unwise to propose still another new species before examining the existing ones in a critical way. However, I had the opportunity during the summer of 1954 to examine type material of most species whose specific names or original descriptions suggested the present moss, especially in the Brotherus herbarium in the Botanical Institute of the University of Helsinki. Finally, until I could see the type material distributed by Drummond, I had abundant reason to suspect that the too brief original description of *Mnium pseudopunctatum* Br. & Sch. (1843) could perfectly well have been based on the present species, instead of on *M. subglobosum*, to which Bruch and Schimper relegated it in their *Bryologia Europaea* (1846). My recent study of the original Drummond collection at the New York Botanical Garden, especially the rich and abundant material from the Mitten Herbarium, shows that number 253 of Drummond's *Musci Americani* is either *M. pseudopunctatum*, in its current (and correct) sense, or else *M. punctatum* var. *elatum*, depending on which set one studies.

Through continued field work in central and arctic Alaska and through the study of several extensive collections made in the northern parts of North America by colleagues, I have gradually found *Mnium andrewsianum* to have a wide and very natural geographic range in continental climatic zones of subarctic and arctic America, and, moreover, that it maintains its morphological constancy throughout. I am especially grateful to Dr. Howard A. Crum, of the National Museum of Canada, for bearing this species in mind, even though it was undescribed, during both his field work and his herbarium studies. As a consequence of his efforts, and the list of specimens he has assembled, our knowledge of its geographic distribution is very considerably increased.

With my original reservations overcome, and with a large number of collections in hand, I believe that it is now advisable to legitimatize a herbarium name that already has caused some confusion and that has, as a *nomen nudum*, crept at least once into print.

It gives me real pleasure to dedicate this species to a distinguished American bryologist, Dr. A. LeRoy Andrews of Cornell University, whose researches over many years have illuminated our knowledge not only of the Mniaceae, but also of the even

more difficult families, in a taxonomic sense, the Bryaceae and Sphagnaceae.

Mnium andrewsianum sp. nov.[2] Plants tufted, often densely and extensively so, usually the dominant species if in mixture with other bryophytes, very small for the genus; whitish- or lustrous-green, with a reddish tinge, when growing, densely felted with reddish-brown radicles in the older growth; stems erect, dark red to nearly black, branching only by innovations, 1-5 cm. high; leaves small for the genus, distant except for the apical cluster, shrunken and much crisped in the current season's growth when dry but surprisingly firm and undistorted in the growth of preceding years, erect-spreading, plane to somewhat concave, gradually narrowed to the base, delicately long-decurrent by a continuation of the cells of the leaf margin to produce narrow but demonstrable wings, from nearly circular to broadly obovate, rarely broader than long, varying greatly in size on the same stem, 1.0-1.5 mm. wide on sterile plants, comal leaves on antheridial and fertile plants 2.0-2.2 mm. wide (exceptionally reaching 2.5 mm.); apex not at all differentiated, neither emarginate nor apiculate; margin bordered throughout with a distinct reddish or brown border consisting generally of a single row (and a single layer) of elongated cells conspicuously differentiated by size and color from the cells of the lamina, not at all modified at the leaf apex but occasionally bistratose and 2-3 rows of cells wide toward the base of the leaf, occasionally slightly sinuous in the upper part, but totally without teeth; costa reddish-brown, unusually short for the genus, strong at the base but tapering to an abrupt end at a point equidistant between the middle of the leaf and the apex; cells of the lamina irregularly polygonal, usually hexagonal, somewhat elongated and tending to be arranged in diagonal rows from the costa upward toward the margin, in the upper part of the lamina, between costa and border, 35-55 μ × 40-75 μ, generally smaller and shorter toward the border, exceptionally variable in size within any small area, walls rather thick, corners with small but clear trigones, cells of border rectangular to linear, longer toward the leaf base, 30 μ × 90-225 μ, very thick-walled, the inner wall conspicuously pitted.

[2] Dense caespitosum, caespites inferne tomento rufo vel nigricante intertexti. Plantae habitus M. pseudopunctatum. Folia remota, erecto-patentia, decurrentia, superiora in rosulam 4-6-phyllam patulam conferta, costa rufa sub apice evanescente, rotundato-obovata, limbo discolore rufescente e simplici serie cellularum formato, haud incrassato. Flores dioici; plantae masculae in cespites propios congregatae, floribus discoideo-capituliformes, paraphysibus antheridiis associatis clavatis. Capsula solitaria, parvula, inclinata, subglobosa, operculo angustiore rectirostri. Peristomium minus, caeterum a M. pseudopunctatum simile.

Dioicous, each sex in large, relatively pure tufts, rarely mixed; antheridial inflorescence a small saucer-shaped head separated from the normal vegetative leaves below it by a stipe-like segment of stem bearing much reduced, convex, bract-like leaves; perigonial leaves few, somewhat larger than and similar to normal vegetational leaves, reaching 2.2 (2.5) mm. in width, somewhat reflexed; paraphyses numerous, clavate, golden-brown when wet, very dark when dry, longer than the yellow antheridia; archegonial plants somewhat taller than the antheridial, perichaetial leaves obovate, much reduced progressively toward the archegonia, the innermost reduced to minute lanceolate bracts. Sporophyte very similar to that of *M. pseudopunctatum;* seta long and slender, reaching 2 cm.; capsules solitary, subglobose, small for the genus, approximately 1.0 × 1.2 mm.; outer peristome teeth brown, the inner yellowish; spores punctate, 25–30 μ in diameter.

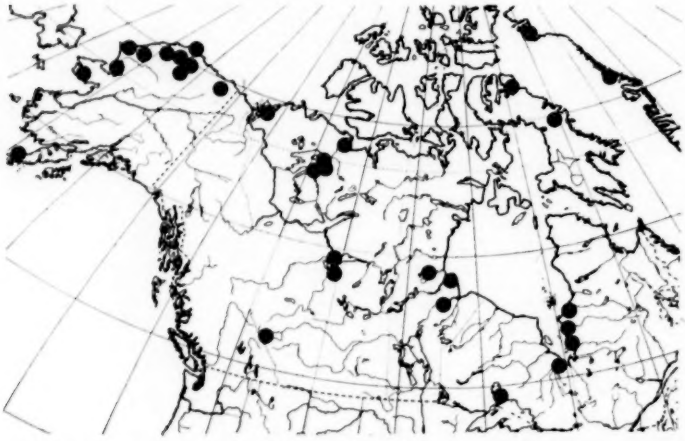
TYPE SPECIMEN: In drainage channel, steep north-facing tundra slope of mountain ridge west of Peters Lake, about 2 miles from inlet to Schrader Lake, just SW. of Mt. Chamberlin, Franklin Mountains, Brooks Range, approx. 69°22′ N. Lat., 145°03′ W. Long., about 3000 ft. alt., July 26, 1952, *Steere* 18615, *c.fr.;* associated species, among others, *Philocrya aspera* Hag. & Jens. and *Lepicolea fryei* Perss. (NYBG).

GEOGRAPHIC DISTRIBUTION: WEST GREENLAND: In bog of outer-coast type, subsoil basalt, Amitsoq, Umiarfik Fjord, Svartenhuk Peninsula, West Greenland, 71°49′ N. Lat., 55°25′ W. Long., July 15, 1956, *K. Holmen* 13020 (det. H. A. Crum); in *Carex*-moss bog meadow 1 mile NE. of Nunatarssuaq Point, Thule District, 76°30′ N. Lat., July 25, 1953, *W. S. Benninghoff* 7558. CANADA: NORTHEAST TERRITORIES, DISTRICT OF FRANKLIN. Baffin Island: Pond Inlet, 72°40′ N. Lat., 78°16′ W. Long., August 29, 1938, *D. Coombs* 21; head of Clyde Inlet, approx. 69°50′ N. Lat., 70°40′ W. Long., July 1, 1950, *Pierre Dansereau* 500701-0486; *V. C. Wynne-Edwards* 9277a, 9282a. DISTRICT OF MACKENZIE. Great Bear Lake: at boggy edge of small lake behind Eldorado Mine, Port Radium, E. end of McTavish Arm, 66°05′ N. Lat., 118°02′ W. Long., July 2, 1948, *Steere* 10074; in very deep wet cleft in cliff, near permanent ice, north of Labine Point, July 4, *Steere* 10136, July 24, *Steere* 10461; in wet place in swamp, Sawmill Bay, NE. tip of Leith Peninsula, July 6, *Steere* 10213; on steep peaty bank, S. shore of Sawmill Bay, July 16, *Steere* 10424; on boggy margin of stream flowing into Hunter Bay, E. of Sloan River, July 31, *Steere* 10602. Coppermine, W. end of Coronation Gulf: in wet places, swampy pockets in hills behind village, 67°47′ N. Lat., 115°30′ W. Long., August 4, *Steere* 10694, 10706,10714, 10741a, 10755, 10778, 10790. Mouth of Mackenzie River: On slope with shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N. Lat., 132°56′ W. Long., August 8, 1957, *W. J. Cody* 10597. QUEBEC: East Coast of Hudson Bay; Beaver River, island off the river mouth, 53°25′ N. Lat., 79° W. Long., July 12, 1947, *J. Kucyniak & R. Tuomikoski* T358; Piagochiwi River, low granite island, 54°09′ N. Lat., 79°12′ W. Long., July 19-20, *Kucyniak & Tuomikoski* K407, T615; springy place in wood, Sucker Creek, lat. 54°58′ N. Lat., 78°35′ W. Long., July 28, 1947, *Tuomikoski*

T1043. ONTARIO: Bois tourbeaux de *Larix laricina*, Attawapiskat, James Bay, August 28, 1946, *Ernest Lepage* 12176; margin of wet depression in wooded bog, Moose Factory, Moose Island, about 51°12′ N. Lat., 80°39′ W. Long., June 28, *Kucyniak & Tuomikoski* T19 and T89; N. shore of Lake Superior, in swamps, Red Rock, June 27, 1884, *J. Macoun* (det. Crum). MANITOBA: At margin of peat bog, with *Carex*, MacBride River area, 56°51′ N. Lat., 99°56′ W. Long., *J. C. Ritchie* 1184, Aug. 31, 1955. In wet places, near Great Island, Seal River, 59°03′ N. Lat., 96°47′ W. Long., July 6, 1956, *Ritchie* 1825, July 14, 1956, *Ritchie* 1949, July 16, *Ritchie* 1964 (all det. Crum); vicinity of Fort Churchill: 3 miles from base at margins of lake, swamp and lichen tundra, on hummocks in swamp, June 27, 1956, *H. A. Crum & W. B. Schofield* 6679, 6682; in wet depression, spruce-tamarack forest and swamp at mile 498, Warkworth Creek (12 miles S. of Fort Churchill), June 29, 1956, *Crum & Schofield* 6756; in swampy place on quartzite outcrops between Churchill and Fort Churchill, July 8, 1956, *Crum & Schofield* 6930, 6944 (♂); in alkaline swamps and spruce-larch stand at margin of Landing Lake, ca. 5 miles S. of Fort Churchill, July 17, 1956, *Crum & Schofield* 7095; in spruce forest, wet, shaded depression, Gillam, August 6, 1956, *Crum* 7522. SASKATCHEWAN: Lake Athabasca, Sept. 2, 1872 (1875?), *J. Macoun* 659 (det. Crum); Athabasca Plains, Sept. 3, 1875, *J. Macoun* 232 (det. Crum). ALBERTA: on wet shaded bank in woods, at edge of tundra near Athabasca Glacier, Columbia Icefields, Jasper National Park, ca. 6300 ft. alt., July 2, 1955, *Crum & Schofield* 4061. ALASKA (arranged from east to west). In wet seepage channel, steep north-facing tundra slope above Peters Lake, area just SW. of Mt. Chamberlin, Franklin Mountains, Brooks Range, approx. 69°22′ N. Lat., 145°03′ W. Long., about 3000 ft. alt., July 26, 1952, *Steere* 18679; wet mountainside above deep gorge N. of Peters Lake, July 28, 1952, *Steere* 18909; wet depression along stream, W. of Peters Lake, July 29, 1952, *Steere* 18698; near stream in deep ravine, W. bluff of Chandler River, 1 mile S. of Gubic (near confluence of the Chandler and Colville Rivers), approx. 69°28′ N. Lat., 151°30′ W. Long., July 24, 1951, *Steere* 16166, in wet tundra near Chandler River, 3-4 miles S. of Gubic, July 24, 1951, *Steere* 16221; Umiat, Colville River, approx. 69°23′ N. Lat., 152°10′ W. Long., July 21, 1949, *George Llano* 1946-K, in wet depression, hillside tundra, ridge E. of Umiat, August 24, 1951, *Steere* 16951, on wet, north-facing tundra hillside, ridges N. of Umiat, June 26, 1952, *Steere* 17095, June 28, 1952, *Steere* 17600; in wet marshy tundra, SW. corner of Chandler Lake, Endicott Mountains, Brooks Range, approx. 68°12′ N. Lat., 152°47′ W. Long., about 3000 ft. alt., July 19, 1952, *Steere* 18223, 18302; in wet depression, on trail to landing lake, steep hillside tundra, below Titaluk Camp, E. of the Ikpikpuk River, approx, 69°30′ N. Lat., 154°30′ W. Long., August 25, 1951, *Steere* 17093; in moist depression, steep hillside on ridge 2-3 miles SW. of Kurupa River Camp, Endicott Mountains, Brooks Range, approx. 68°24′ N. Lat., 154°51′ W. Long., about 3000 ft. alt., July 2, 1952, *Steere* 17728, 17753, in wet depression, steep hillside, above canyon of Kurupa River, 3700 ft. alt., July 3, 1952, *Steere* 17820; in wet depression along stream about 3 miles N. of East Oumalik Camp, approx. 69°48′ N. Lat., 155°23′ W. Long., July 7, 1951, *Steere* 15519; in wet depression, tundra hillside, northern face of Mt. Araga, S. of Smith Lakes, just W. of Etivluk River, Endicott Mountains, Brooks Range, approx. 68°43′ N. Lat., 156°30′ W. Long., about 2000 ft. alt., July 12, 1952, *Steere* 17868; in open marsh very near shore of Elson Lagoon, E. of Point Barrow Base, approx. 71°20′

N. Lat., 156°39′ W. Long., June 25, 1951, *Steere* 15151; in wet depression between high-center frost polygons in flat marshy tundra, S. of Meade River Camp, approx. 70°39′ N. Lat., 156°55′ W. Long., July 13, 1951, *Steere* 15812; in tundra near airstrip, Port Heiden, N. side of Alaska Peninsula, 56°54′ N. Lat., 158°36′ W. Long., August 23, 1949, *Steere* 14664, 14671, 14672, 14710, 14712; in depression, wet, flat tundra below Driftwood Camp, near headwaters of the Utukok River, N. slope of DeLong Mountains, Brooks Range, approx. 68°53′ N. Lat., 161°10′ W. Long., August 7, 1951, *Steere* 16657, August 9, 1951, *Steere* 16706; in tundra behind village of Kotzebue, approx. 65°53′ N. Lat., 162°33′ W. Long., July 22-24, 1953, *Steere* & *Crum* 20307; 10 miles NE. of Nome along Nome River, June 30, 1950, *Herbert C. Hanson* 54; in moist tundra near Cape Lisburne, north side, approx. 68°52′ N. Lat., 166°15′ W. Long., July 29, *Steere* & *Crum* 20703.

The collections just cited will serve to establish the continental pattern of distribution of the species (MAP 1), and will also designate specimens that typify my concept of *Mnium andrewsianum*. I am sure that this species has a much wider geographic distribution than indicated here and that a re-examination of herbarium material now filed under *M. punctatum* and *M. pseudopunctatum* must reveal many more specimens of *M. andrewsianum*. That this prediction is reasonably safe is demonstrated by a Nilsson-Ehle collection of *M. andrewsianum* from Siberia in the Brotherus herbarium (as *Astrophyllum punctatum*). The following data are given: "Sibiria: in valle flum. Lena, Kumachsur, 70°30′ L.N. 18/7/1898. H. Nilsson-Ehle, det. H. W. Arnell" (*cf.* Arnell, 1913).



MAP 1. The geographical distribution of *Mnium andrewsianum* in subarctic and arctic North America.

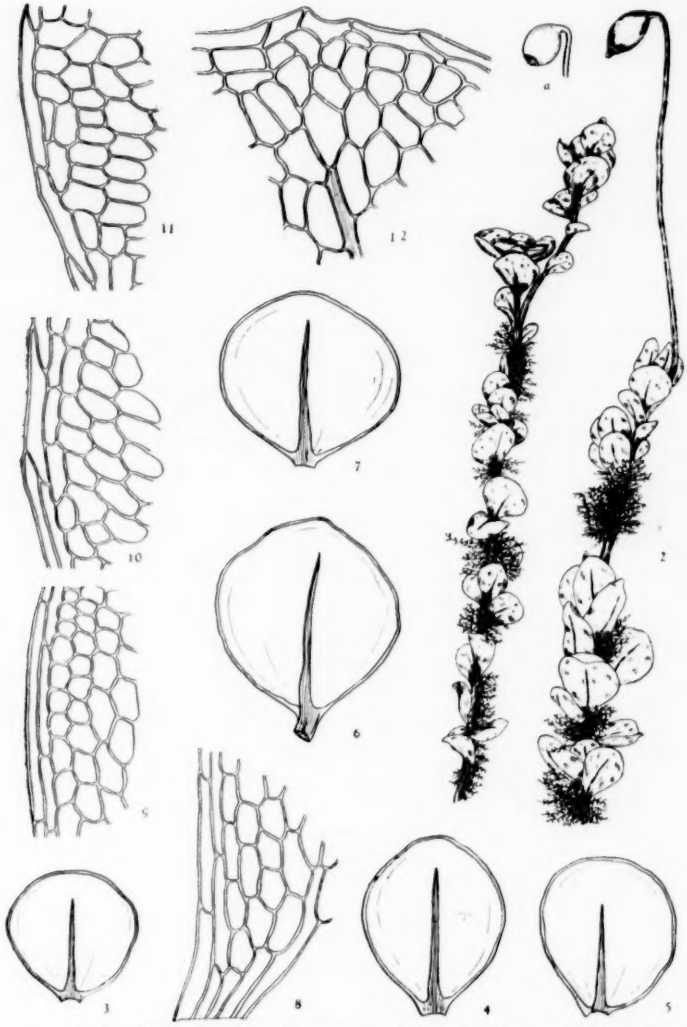


FIG. 1-12. *Mnium andrewsianum*. 1. Habit of moist antheridial plant; perigonial leaves of antheridial head not as clearly differentiated from vegetative leaves as usual, × 4. 2. Archegonial plant with sporophyte; capsule not quite mature, to show operculum, × 4. 2a. Mature, deoperculate capsule, × 4. 3-5. Vegetative leaves from stem, × 14. 6, 7. Leaves from apex of stem, × 14. 8-12. Cellular detail of sectors of a leaf, in ascending order, from the basal margin to the apex, × 75. (Figures 1, 2, 2a by Mr. Wilfred B. Schofield; figures 3-12 by Miss Jennifer Wootton.)

RELATIONSHIPS: Without doubt, *Mnium andrewsianum* belongs to the species complex of which *M. punctatum* Hedw. is the most common as well as the first to be described. Andrews, in his masterly monograph of the North American species of Mniaceae in Grout's *Moss Flora of North America* (1940), treated the whole complex rather conservatively as one extremely variable species, so that *M. andrewsianum* would not only be identified as *M. punctatum* by his key but would also fit his description moderately well. However, without meaning to seem contentious, I consider *M. andrewsianum* to be a well-marked and consistently distinct species, rather easily separated from related species by a unique combination of characters. The most important features that set it apart follow: the very small stature of the plants, the dioicous inflorescence with stipitate antheridial heads, the almost circular leaves in which the costa ends far below the apex, the continuation of the marginal cells into delicate decurrent wings, the unistratose, one-cell wide margin in the upper part of the leaf, and the complete lack of an apiculus or other modification of the leaf apex. Sporophytes are exceedingly rare and quite similar in appearance to those of *M. pseudopunctatum*—and within the *M. punctatum* complex, *M. andrewsianum* appears to be most closely related to *M. pseudopunctatum*, whose extremely brief original description applies equally well to either species, as follows (Bruch & Schimper, 1843):

> 253. *Bryum punctatum.* This plant resembles certain small-leaved forms of Mnium punctatum; it differs, however, essentially from that species in its more delicate leaves, which are not terminated by a short mucro, and which are bordered with a loose cellular margin; the male flowers are also different. We, therefore, must regard this elegant moss as a distinct species, which may be called Mnium pseudopunctatum.

I was especially puzzled by the reference to "male flowers," which would seem to imply a dioicous condition, and I consequently anticipated finding a species other than the monoicous one that Bruch and Schimper later (1846) called *M. subglobosum*—perhaps even the present species—when opportunity finally arose to examine the original material collected by Drummond. However, what is obviously a part of the original collection upon which Bruch and Schimper based *M. pseudopunctatum* is consistently monoicous, has abundant sporophytes and matches exactly my own concept, gained from field observations in northern Michigan, of this species. The only way in which I can explain the ambiguous reference to "male flowers" is that R. J. Shuttleworth, in translating Bruch and Schimper's notes on the Drummond exsic-

cati from the German, unintentionally may have altered the wording slightly, since a major difference between *M. punctatum* and *M. pseudopunctatum* is, of course, their dioicous and monoicous inflorescences, respectively.

The lack of uniformity between the same numbers in different sets of Drummond's *Musci Americani* presents a serious hazard in bryological research, to such an extent that no final or critical decision may be made on the basis of examination of just one set. This problem is well illustrated by Drummond's numbers 253 and 254 in the herbarium of the New York Botanical Garden. Mrs. Britton evidenced her full appreciation of this frustrating situation by her copious notes that accompany the specimens, as well as by her inquiries about Drummond sets in other herbaria.

In his *Musci Americani,* Drummond (1828) issued number 253 under the name of *Bryum punctatum,* "HAB.—Moist woods and marshes," without further information. His number 254, issued as *Bryum punctatum* var. *major,* bears the note "HAB.—Near Lake Huron; in marshy situations." From Mitten's herbarium, from fragments sent to Mrs. Britton by Macoun of his set, and from a note to Mrs. Britton from the Kew Herbarium dated April 8, 1895 (signed "C.H.W."), we achieve a good picture of the poor correlation between label and specimen in Drummond's exsiccati. The following table summarizes the information available in the New York Botanical Garden:

SET:	NUMBER 253	NUMBER 254
Macoun	*M. punctatum* var. *elatum*	*M. punctatum* var. *elatum*
Macoun (2)	*M. punctatum*	
Mitten	*M. pseudopunctatum*	*M. punctatum* var. *elatum*
Mitten (2)		*M. punctatum* var. *elatum*
Kew	*M. punctatum* var. *elatum*	*M. pseudopunctatum*
Bruch	*M. pseudopunctatum*	
Drummond	*M. pseudopunctatum*	*M. punctatum* var. *elatum*

In conclusion, it has been confirmed that the present concept of *Mnium pseudopunctatum* agrees with the type material collected by Drummond and that *M. andrewsianum* is specifically distinct from it. However, it is of considerable interest to note here that Drummond *did* collect *M. andrewsianum.* A small but typical fragment in the Mitten herbarium is accompanied by the following remarks, in Mitten's script, "M. pumilum Wils. Ms., N. America, Drummond, c 272," with no further specification of locality. In this connection, it is especially surprising that Mitten mentioned neither Wilson's manuscript species nor *M. pseudopunctatum* in his "'Bryologia' of the survey of the 49th Parallel" (1865), the

first substantial treatment of Canadian mosses, because of his reference to so many other Drummond collections, several of which are described as new species.

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BRYOPHYTA OF ARCTIC AMERICA. VII. A COLLECTION FROM THE DELTA REGION OF THE MACKENZIE RIVER

WILLIAM CAMPBELL STEERE[1]

The bryophytes of arctic Canada west of Hudson Bay have received scant attention since the classic publications of Brown (1823) and of Richardson (1823), even though those of the Canadian Eastern Arctic are relatively well known (Steere, 1948). My own extensive collections from Great Bear Lake and from Coppermine, made during the summer of 1948, contain so many puzzles that they still remain incompletely studied and unreported. Consequently, in the hope of shedding light on some of the taxonomic problems in my own collections, I agreed with alacrity to study a small collection made during the summer of 1957 by Mr. W. J. Cody, of the Canadian Department of Agriculture, in the complex delta region of the mouth of the great north-flowing Mackenzie River. The areas and localities in which Mr. Cody

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collected mosses and hepatics are primarily the East Channel of the Mackenzie River, the Eskimo Lakes region, Sitidgi Lake in the Eskimo Lake Basin, Reindeer Station, Tummuk, Kidluit Bay on the northeast side of Richards Island, and Tuktuk (Port Brabant), extending between 68°41′ and 69°47′ North Latitude and between 131°02′ and 134°37′ West Longitude.

Some of the species reported here have a very wide distribution in the Northern Hemisphere, others are weedy species of areas that are continually disturbed by man, by fire, or by other factors, and some are of considerable interest for the new information they give us on the geographic distribution of bryophytes in arctic North America. The presence of wholly unexpected species in this collection, as well as the absence of many cosmopolitan and weedy species, indicates clearly that careful bryological research in the delta region of the Mackenzie River might be unusually rewarding, beyond all anticipation. Since so few bryophytes have been reported from the mouth of the Mackenzie River, all species of the present collection will be listed here, for the record, whether rare or ubiquitous. The potential richness of the Mackenzie Delta is shown by the reports (Williams, 1921) of *Sphagnum fuscum* from Herschel Island, *Mnium affine* from Shingle Point, at the western edge of the Mackenzie River delta, and *Drepanocladus wilsoni* and *Callieron giganteum* from Cape Bathurst, yet none of these species turned up in the present collection.

Hepaticae

Riccardia pinguis (L.) S. F. Gray. In old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10138; Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10597.

Calypogeia fissa (L.) Raddi. In old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10138.

Calypogeia meylanii Buch. In lichen-heath tundra, Eskimo Lakes, N.W. side of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, 10605.

Cephaloziella subdentata Warnst. In minor admixture with the preceding species (10605).

Barbilophozia hatcheri (Evans) Loeske. On creek bank, Eskimo Lake Basin, Sitidgi Creek about 1 mi. downstream from Sitidgi Lake, 68°41′ N., 132°50′ W., Aug. 11, 10820.

Gymnocolea inflata (Huds.) Dum. In moist depression in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidigi Lake, 68°41′ N., 132°48′ W., Aug. 11, 10799.

Jungermannia sphaerocarpa Hook. With the preceding species, in admixture (10799).

Lophozia alpestris (Schleich.) Evans. On slope, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, *10597.

* Collection numbers marked with an asterisk (*) indicate that the species under which they are listed are the dominant or co-dominant species.

LOPHOZIA VENTRICOSA (Dicks.) Dum. *emend.* Buch. On dry shrub-heath tundra, Eskimo Lakes, NW. shore of second lake from W., 68°54′ N., 133° 14′ W., Aug. 9, 10634; in moist depression in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, 10801; on creek bank, Eskimo Lake Basin, Sitidgi Creek about 1 mi. downstream from Sitidgi Lake, 68°41′ N., 132°50′ W., Aug. 11, 10820.

ORTHOCAULIS BINSTEADII (Kaal.) Buch. In old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10138; moist situation among heaths, Eskimo Lakes, S. end of westernmost lake at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, 10784.

SPHENOLOBUS MINUTUS (Crantz) Steph. In moist tundra valley, base of Caribou Hills, East Channel Mackenzie River, 3 mi. NW. of Reindeer Station, 68°44′ N., 134°13′ W., July 17, 10084; on lichen-heath tundra, Eskimo Lakes, NW. side of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, 10605, 10634; in moist situation among heaths, Eskimo Lakes, S. end of westernmost lake, at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, 10784, 10785.

CEPHALOZIA LACINULATA (Jack) Spruce. Moist depression in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, 10799.

CEPHALOZIA PLENICEPS (Aust.) Lindb. On creek bank, Eskimo Lake Basin, Sitidgi Creek about 1 mi. downstream from Sitidgi Lake, 68°41′ N., 132°50′ W., Aug. 11, 10820.

MARCHANTIA POLYMORPHA L. On rich moist organic soil in settlement area, Reindeer Station, 68°42′ N., 134°08′ W., June 11, *9579; in hollows in burnt-over (1954) area, "Burnt Lake," Eskimo Lake Basin, 68°52′ N., 132°05′ W., July 18, *10105A, 10106A; in moist burnt-over area, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10135; in moist sandy gravel of sand spit, Eskimo Lakes, S. end of westernmost lake at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, 10747; on mud bank of creek, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, 10812; peaty lake bank, small lake about 6 mi. S. of McKinley Bay, 69°47′ N., 131°02′ W., Aug. 15, 10931.

MUSCI

SPHAGNUM GIRGENSOHNII Russ. Near edge of puddle under shrubs, Reindeer Station, top of Caribou Hills, 68°42′ N., 134°08′ W., Aug. 16, *10958, 10959.

SPHAGNUM PLUMULOSUM Röll. Old *Sphagnum* mat, overgrown with mosses, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10138.

SPHAGNUM RECURVUM P.-Beauv. Under shade of shrubs in moist ground, Reindeer Station, top of Caribou Hills, 68°42′ N., 134°08′ W., Aug. 16, as a minor admixture in the following species (10958).

SPHAGNUM RUBELLUM Wils. In the same locality as the preceding species as the dominant species in the collection, *10958.

SPHAGNUM SQUARROSUM Crome. In hollows among tussocks in wet ground, in partial shade of shrubs, Reindeer Station, top of Caribou Hills, 68°42′ N., 134°08′ W., Aug. 16, *10959.

CERATODON PURPUREUS (Hedw.) Brid. By far the most common species in the collection; always with sporophytes. *9602, *9687, *9756, 10105A, *10106A, *10135, *10151, 10229, 10597, 10712, 10714, 10733, 10747, 10812, 10813, *10814, *10931.

DISTICHIUM CAPILLACEUM (Hedw.) BSG. On hummocks in tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, 9889; on moist sandy soil among scrubby *Salix* on slope, Warren Point, 69°44′ N., 132°30′ W., July 26, 10229. In both collections this usually weedy species was only a minor admixture with *Pottia heimii*, the dominant species.

DISTICHIUM INCLINATUM (Hedw.) BSG. In wet sand at delta of creek just N. of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68° 48′ N., 133°24′ W., Aug. 10, *10682, in shallow water in embayment behind sand spit near mouth of Stanley Creek, *10715.

DITRICHUM FLEXICAULE (Schw.) Hampe. On slope among shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N. 132°56′ W., Aug. 8, 10597; on sand spit near mouth of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°46′ N. 133°24′ W., Aug. 10, 10715.

DICRANELLA CRISPA (Hedw.) Schimp. On mud bank of creek, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10813, 10814.

DICRANUM ANGUSTUM Lindb. On slope among shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10597; moist situation among heaths, Eskimo Lakes, S. end of westernmost lake, at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, *10784.

DICRANUM ELONGATUM Schleich. In moist tundra valley, base of Caribou Hills, East Channel Mackenzie River, 3 mi. NW. of Reindeer Station, 68° 44′ N., 134°13′ W., July 17, 10084; on lichen-heath tundra, Eskimo Lakes, NW. side of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, 10605; moist situation among heaths, Eskimo Lakes, S. end of westernmost lake, at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, *10785; in open tundra with shrubs, Eskimo Lakes, Stanley Creek, W. side of westernmost lake, 68°46′ N., 133°24′ W., Aug. 12, 10870.

DICRANUM FUSCESCENS Turn. On tundra, Tummuk, Mackenzie River East Branch, 69°00′ N., 134°37′ W., June 14, 9602; in moist tundra valley, base of Caribou Hills, East Channel Mackenzie River, 3 miles NW. of Reindeer Station, 68°44′ N., 134°13′ W., July 17, 10085; on lichen-heath tundra, Eskimo Lakes, NW. side of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, 10605; in open shrubby tundra, Eskimo Lakes, Stanley Creek, W. side of westernmost lake, 68°46′ N., 133°24′ W., Aug. 12, 10870.

ENCALYPTA RHABDOCARPA Schw. On tundra, Tummuk, Mackenzie River East Branch, 69°00′ N., 134°37′ W., June 14, 9602.

BARBULA CONVOLUTA Hedw. On hummock on tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, 9889.

BARBULA ICMADOPHILA Schimp. Also a minor admixture with the preceding species, in the same collection (9889).

DESMATODON LAUREri (Schultz) BSG. A minor element in the same collection as the two preceding species (9889), *c.fr.*

POTTIA HEIMII (Hedw.) Fürnr. On hummock in tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, *9889; in moist sandy soil among scrubby *Salix* on slopes, Warren Point, 69°44′ N., 132°30′ W., July 26, *10229; on black sandy soil among grasses, Toker Point, 69°38′ N., 132°54′ W., July 28, 10316. Williams (1921) reported *Pottia heimii* var. *obtusifolia* from Cape Bathurst.

TORTELLA FRAGILIS (Hook & Wils.) Limpr. On tundra, Tummuk, Mackenzie River East Branch, 69°00′ N., 134°37′ W., June 14, 9602.

TORTULA MUCRONIFOLIA Schw. On tundra, with the preceding species, in the same collection (9602); on moist sandy soil among scrubby *Salix* on

slope, Warren Point, 69°44′ N., 132°30′ W., July 26, 10229, *c.fr.;* in shade on moist sand bank near mouth of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°46′ N., 133°24′ W., Aug. 10, *10712, *c.fr.* The last collection cited, with abundant sporophytes, has the costa unusually well developed and much more longly excurrent than typical for this species.

DISCELIUM NUDUM (Dicks.) Brid. On mud bank of creek, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10813, *c.fr.*

This collection is in excellent condition, with sporophytes of all ages, from very young green spears to old weathered capsules. The persistent protonemata, the characteristic peristome teeth, and the unmistakable habit of the plants can leave no room for doubt about the idenification of this easily recognized species, in spite of this astonishing extension of its known geographic range in North America, where previously it has been known only from two widely separated regions. In the East, it is apparently not rare locally in suitable habitats in New York, New Jersey, Pennsylvania, Ohio and Illinois. In the West, a surprising extension of range was reported by Bailey (1933), on the basis of a collection made by T. C. Frye at Kalalock, Washington, on the western border of the Olympic Peninsula.

C. F. Austin (1878) seems to have been the first to have distributed American material of *Discelium nudum,* in his *Musci Appalachiani,* as number 505 of the first supplement. His notes raise some further questions, as he says: "HAB. Clay banks, Bethlehem, Pa., *Rau;* Ohio, *Beardslee;* also Canada and westward to Vancouver's Island, *Macoun.*" Curiously enough, neither Macoun (1892, 1902) nor Kindberg (1897) reported this species from Canada in their comprehensive catalogues. Howard Crum (personal communication) has generously furnished the following information: "The Vancouver Is. record *may* be based on a specimen at the New York Botanical Garden from 'Fraser River Valley, *Macoun,* May 17, 1875'; it is *Mniobryum atropurpureum.* We have a specimen [National Museum of Canada, Ottawa] labelled in John Macoun's hand, "Boggarts Hole Clough, 1871," but without collector. I think this is probably a Macoun collection from the vicinity of Owen Sound, Ont., as he collected there in the summer of 1871 (see his autobiography). I cannot get any information on Boggart's Hole, although there is a lake and an island by that name in the Georgian Bay area." In his autobiography, Macoun (1922) tells of spending his summer holiday of 1871 near Owen Sound. He says (p. 45) "We collected many mosses and flowering plants, the former of which were sent to Professor James, who was then preparing his Manual of North American Mosses." However, in this Manual, James (Lesquereux & James, 1884) does not mention Canada in the geographic range of *Discelium;* in fact, he cites only Wolf's Illinois collection. The first unquestionable Canadian material to be reported is apparently from Nova Scotia, collected by Dr. John Somers in 1877 (Brown, 1946).

Discelium is widely distributed elsewhere in the world, and has been reported from Scandinavia, the British Isles, northern, central and eastern Europe, Finland, Russia, Siberia and Sacchalin Island. According to Möller (1936), *Discelium* reaches or extends beyond the Arctic Circle in Norway, Sweden, Finland and Russia, reaching 68°25′ N. at Fagernaes in Nordland, northern Norway, 67°55′ N. at Muonionniska, in Pajala, northern Finland, and the Murmansk region of European Russia. The northernmost collections made in Siberia are apparently those made independently by J. Sahlberg and by H. W. Arnell at Verknje Imbatschna on the Jenisei River, at a North Latitude of 63°15′ (Lindberg & Arnell, 1890). The northern exten-

sion of *Discelium nudum* in Europe and in Asia makes more reasonable its occurrence in arctic Canada. The existence of this species in northern Siberia and in northern Canada makes highly probable its eventual discovery in Alaska, in suitable habitats.

FUNARIA HYGROMETRICA Hedw. In burnt-over (1954) area, "Burnt Lake," Eskimo Lake Basin, 68°52′ N., 132°05′ W., July 18, 10106A. This weedy species, which usually occupies habitats altered by man's activities, is surprisingly uncommon in Cody's collections and was found only as a minor component in a dominant population of *Ceratodon purpureus*.

FUNARIA MICROSTOMA BSG. var. OBTUSIFOLIA Grout. On mud bank of creek, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10812. This well-characterized variety was originally described from Bonanza Creek, near Dawson, in the Yukon Territory, but its geographic distribution in North America is still not well determined.

BRYUM ARCTICUM (R. Br.) BSG. On sand spit near mouth of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°46′ N., 133°46′ W., Aug. 10, 10715.

BRYUM ARGENTEUM Hedw. On moist sand bank near mouth of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°46′ N., 133°24′ W., Aug. 10, 10712.

BRYUM CAPILLARE Hedw. On hummocks in tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, 9889; on moist sandy soil among scrubby *Salix* on slope, Warren Point, 69°44′ N., 132°30′ W., July 26, 10229.

BRYUM CUSPIDATUM (BSG.) Schimp. In low moist hummocky tundra, Old Army Camp, East Channel Mackenzie River, 69°17′ N., 133°54′ W., July 1, 9756; in moist burnt-over area, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°27′ W., July 18, 10135; on moist sandy gravel shore, Eskimo Lakes, W. side of westernmost lake, 68°45′ N., 133°19′ W., Aug. 11, *10734.

BRYUM INCLINATUM (Web. & Mohr) Sturm. In tuft on tundra, Tummuk, Mackenzie River East Branch, 69°00′ N., 134°37′ W., June 14, 9602; on hummocks on tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, 9889.

LEPTOBRYUM PYRIFORME (Hedw.) Schimp. A common and weedy species throughout North America—and the world. Represented in Cody's collection by several numbers: 9579, 9889, 10105A, 10229, *10316, *10747, 10812, 10813, 10814, 10931.

POHLIA CRUDA (Hedw.) Lindb. On old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10138; mud bank of creek, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10814.

POHLIA NUTANS (Hedw.) Lindb. In moist shrubby tundra valley, base of Caribou Hills, East Channel Mackenzie River, 3 mi. NW. of Reindeer Station, 68°44′ N., 134°13′ W., July 17, 10084, *10085; in old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°27′ W., July 18, 10138, *10138A; on slope with shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10597; on lichen-heath tundra Eskimo Lakes, NW. side of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, *10605, 10634; in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10799, 10801.

POHLIA PROLIGERA Lindb. On peaty lake bank, small lake about 6 mi. S. of McKinley Bay, 69°47′ N., 131°02′ W., Aug. 15, 10931.

MNIUM ANDREWSIANUM Steere. On slope with shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8,

10597. Although described as a new species only very recently, this moss has been recognized as distinct for nearly ten years, and has carried this name in the herbarium. Because of the delay in publication, we now know that this species has a very wide distribution in arctic and subarctic North America, ranging from Greenland to westernmost Alaska.

AULACOMNIUM PALUSTRE (Hedw.) Schw. In old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10138A; on moist shrubby slope, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10597; in lichen-heath tundra, Eskimo Lakes, NW. side of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, 10605; moist depression in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10801, 10814.

AULACOMNIUM TURGIDUM (Wahl.) Schw. On hummock among grasses, Reindeer Station, 68°42′ N., 134°08′ W., June 27, 9687; in hollows in burnt-over area (1954), "Burnt Lakes," Eskimo Lake Basin, 68°52′ N. 132°05′ W., July 18, 10105A; in moist burnt-over area, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, 10135; among heaths, Eskimo Lakes, S. end of westernmost lake, at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, 10784; mud bank of creek, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, 10812, 10814.

CALLIERGON STRAMINEUM (Brid.) Kindb. In hollow among tussocks, Reindeer Station, top of Caribou Hills, 68°42′ N., 134°08′ W., Aug. 16, 10958, 10958A.

CALLIERGON TURGESCENS (Schimp.) Kindb. In water, sand spits at mouth of creek just N. of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°48′ N., 133°24′ W., Aug. 10, *10696.

CAMPYLIUM CHRYSOPHYLLUM (Brid.) Bryhn. On hummocks on tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, 9889. This identification is open to some question, as the leaves are more homomallous and the costa better developed than is normal for the species in its typical form, yet there seems to be no described variety to fit this present form.

CAMPYLIUM STELLATUM (Hedw.) Lange & C. Jens. In water, sand spits at mouth of creek just N. of Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°48′ N., 133°24′ W., Aug. 10, 10696.

DREPANOCLADUS ADUNCUS (Hedw.) Warnst. With the preceding species, as an additional admixture (10696). This ubiquitous species has been reported from Shingle Point, at the western edge of the Mackenzie River delta (Williams, 1921).

DREPANOCLADUS BREVIFOLIUS Lindb. With the preceding two species, as a co-dominant (*10696).

DREPANOCLADUS TUNDRAE (Arn.) Loeske. Forming deep mat in tundra pool, Mackenzie River delta, NE. side of Richards Island, Kidluit Bay, 69°31′ N., 133°48′ W., July 11, *9994. This collection is of especial interest because it fills a gap in the distribution of a species as yet little known in North America. Tuomikoski (1949), in his brilliant work on this and its related species, cites two collections from Yukon, as well as several of his own collections from Ontario, south of James Bay, and others from Quebec, from the east coast of James Bay and Hudson Bay.

DREPANOCLADUS UNCINATUS (Hedw.) Warnst. On moist slope with shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10597; on moist sandy gravel shore, Eskimo Lakes, W. side of westernmost lake, 68°45′ N., 133°19′ W., Aug. 11, *10733, 10734; moist depression in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi

Lake, 68°41′ N., 132°48′ W., Aug. 11, 10800, 10801; creek bank, Eskimo Lake Basin, Sitidgi Creek about 1 mi. downstream from Sitidgi Lake, 68°41′ N., 132°50′ W., Aug. 11, 10820.

TOMENTHYPNUM NITENS (Hedw.) Loeske. On moist slope with shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10597.

BRACHYTHECIUM ALBICANS (Hedw.) BSG. On hummock in tundra, Tuktuk (Port Brabant), 69°27′ N., 133°02′ W., July 9, 9889; in old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°27′ W., July 18, 10138.

HYPNUM CALLICHROUM Brid. In lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, *10800, *c.fr.* This colletion is beautifully developed, with sporophytes in abundance, and yet was puzzling in one particular—the long-filiform acumination of the leaves is clearly and sharply serrulate. On examination of a considerable series of specimens from the Northern Hemsphere, I discovered that the existence of serrulate acuminations is much more common than the standard descriptions given in manuals would seem to indicate. For example, the acuminations of the leaves in Bauer's 1677 are as serrulate as in the present material, and my own collections from arctic Alaska likewise show this character which I had previously overlooked. The delicate filiform acuminations are much too long and flexuose for *H. dieckii* Ren. & Card.

ISOPTERYGIUM PULCHELLUM (Hedw.) Jaeg. In tuft on tundra, Tummuk, Mackenzie River East Branch, 69°00′ N., 134°37′ W., June 14, 9602.

HYLOCOMIUM SPLENDENS (Hedw.) BSG. On moist slope with shrubs, Eskimo Lakes, island at E. end of second lake from W., 68°56′ N., 132°56′ W., Aug. 8, 10595. This ordinarily common and abundant species is remarkably infrequent in this collection.

POLYTRICHUM COMMUNE Hedw. On creek bank, Eskimo Lake Basin, Sitidgi Creek about 1 mi. downstream from Sitidgi Lake, 68°41′ N., 132°50′ W., Aug. 11, *10820.

POLYTRICHUM JUNIPERINUM Hedw. In hollows in burnt-over (1954) area, "Burnt Lake," Eskimo Lake Basin, 68°52′ N., 132°05′ W., July 18, 10106A; on moist sand on beach, near Stanley Creek, Eskimo Lakes, W. side of westernmost lake, 68°46′ N., 133°24′ W., Aug. 10, 10714; in lichen-heath tundra, Eskimo Lake Basin, outlet of Sitidgi Lake, 68°41′ N., 132°48′ W., Aug. 11, 10800, 10814.

POLYTRICHUM PILIFERUM Hedw. On hummock among grass, with *Ceratodon*, Reindeer Station, 68°42′ N., 134°08′ W., June 27, 9687.

POLYTRICHUM STRICTUM Banks. Moist tundra valley with shrubs, base of Caribou Hills, East Channel Mackenzie River, 3 mi. NW. of Reindeer Station, 68°44′ N., 134°13′ W., July 17, 10084, 10085; on dry shrub tundra, Eskimo Lakes, NW. shore of second lake from W., 68°54′ N., 133°14′ W., Aug. 9, 10634; moist situation among heaths, Eskimo Lakes, S. end of westernmost lake, at mouth of Sitidgi Creek, 68°41′ N., 132°55′ W., Aug. 11, *10785; outlet of Sitidgi Lake, 10801, Sitidgi Creek about 1 mi. downstream from Sitidgi Lake, *10820; on open shrub-lichen tundra, Eskimo Lakes, Stanley Creek, W. side of westernmost lake, 68°46′ N., 133°24′ W., Aug. 12, *10870.

POLYTRICHUM YUKONENSE Card. & Thér. In old *Sphagnum* mat, "Moose Lake," Eskimo Lake Basin, 69°06′ N., 132°37′ W., July 18, *10138. This fine and clear-cut ally of *P. commune* Hedw., to which Frye (1937) subordinated it as a variety, was originally described from the Yukon River

valley, on the basis of a collection made by Dall. Frye also cites a specimen from Port Burwell, in northernmost Quebec, so that the present material fills in a large gap in the known distribution of this moss and gives it a much more natural geographic range.

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FACTORS REGULATING THE INITIAL DEVELOPMENT OF GEMMAE IN MARCHANTIA POLYMORPHA

NIINA TARÉN[1]

The structure, germination and development of the gemmae of *Marchantia polymorpha* are characterized by extreme simplicity in morphology. Physiologically, however, the development and especially germination of the gemmae are relatively complicated processes.

The lenticular gemmae are produced in receptacles that are attached to the thallus over relatively wide areas. The wall of the receptacle is multi-layered at its base, but becomes thinner upward and divides into five triangular lobes. The gemmae develop on papillae which project from the epidermal tissue at the bottom of the receptacle and grow upward supported by club-like hairs which excrete slime. When they are detached from their short stalks, the gemmae are yet incompletely developed. Both sides of the gemmae are morphologically and physiologically identical. In addition to cells containing chloroplast and starch, there are oil bodies and, in the center of the gemma, rhizoid initials. The germination of the gemma involves two processes: the appearance of rhizoids and the initiation of growth at the growth centers. The germination of the gemmae rarely takes place in the receptacle where only intercalary growth occurs (*fig.* 1). Immediately after it leaves the receptacle, however, the gemma begins to germinate. Branches develop from both growth centers

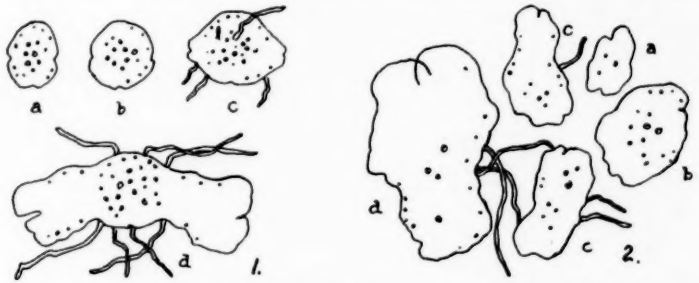

FIG. 1. Normal development of gemmae; *a*, *b*, ungerminated gemmae with some intercalary growth in *b*; *c*, germinated gemma; *d*, young thallus. Ca. × 16. FIG. 2. A culture two weeks old; *a*, *b*, gemmae from the bottom of the receptacle; *c*, gemmae from the middle of the receptacle; *d*, control gemmae on agar. Ca. × 20.

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so rapidly that a dorsiventral thallus, ten times the size of the gemma, develops during one week.

The part played by various environmental factors on the germination of the gemmae outside the receptacle and the dorsiventralization of the gemmae has been elucidated in great detail (mainly by Fitting, 1936a, b, 1937a, b, 1938). An unconditional prerequisite for germination is the presence of water in the substrate (Pfeffer, 1871; Förster, 1927). Nutrient salts, on the other hand, are not necessary (Ehring, 1934). Although the gemmae do not usually germinate in the dark (Pfeffer, 1871; Stephan, 1928), Fitting (1939) noted that gemmae sensitized by light do germinate even in the dark. He also succeeded in getting the gemmae to germinate without light sensitization by adding β-indolylacetic acid to the substrate. Fructose did not have any such effect. A high temperature promotes the germination (Dachnowski, 1907) and also heat absorbed by the gemmae before their germination accelerates the germination process (Fitting, 1942). Rousseau (1950, 1951, 1954a) found that β-indolylacetic acid, β-indolylpropionic acid, α-naphthoxyacetic acid and β-naphthoxyacetic acid strongly promote the growth of rhizoids on the dorsal side of the gemma and interfere with the division of the initial cells so that cells of abnormal length are produced. Coumarine (Rousseau, 1954b) and parasorbic acid (Moewus & Schader, 1951) inhibit the development of the rhizoids and growth of the gemmae.

The inhibition of germination in the receptacle has been studied only by Oppenheimer (1922) who induced germination of part of the gemmae by adding a few drops of nutrient solution into the receptacle. He also placed germinated gemmae back into the receptacle and noted that the inhibiting substance assumed to be present was no longer able to arrest the growth of the gemmae. Oppenheimer (*l.c.*) also macerated several receptacles and planted some gemmae in the mass. The gemmae grew on this substrate as well as control gemmae placed on blotting paper soaked in nutrient solution. Goedecke (1935) attempted to isolate growth substances from the gemmae, peduncles and thallus into agar, but was not successful. From this he concluded that the growth substance in *Marchantia* is not an auxin.

In the present study the inhibition of germination of gemmae of *Marchantia* in the receptacle and the influence of the parent plant on the development of the gemmae have been re-investigated.

Material and Methods

The material comprised *Marchantia* plants bearing receptacles collected from October to December 1953 and in September 1954,

from mud around the spring Myllylähde, Oripää, southwestern Finland. The plants were stored under conditions resembling as closely as possible those in nature with respect to moisture, light and temperature. This type of material is, however, never homogeneous since the germination of the gemmae is dependent on the age of the thallus, the receptacle and the gemmae and on whether the receptacle has developed on a vegetative or fertile thallus (Dachnowski, 1907). In the experiments it was established that the effect of the germination inhibitor was weaker in material collected in September 1954 than in that collected in October 1953, although both materials were freshly gathered. This variation was evidently due not only to the different ages of the materials but also to altered natural conditions. The summer of 1954 was exceptionally rainy, and the thalli and receptacles had been under water several times. In October 1954, the content of inhibiting substance had again increased so that its effect was practically the same as in the preceding year.

The growth medium employed was a 1.5% nutrient agar. The nutrient solution (Waris, 1953) had the following composition: KNO_3, 1 g.; $(NH_4)_2\ HPO_4$, 0.2 g.; $MgSO_4 \cdot 7\ H_2O$, 0.2 g.; $CaSO_4 \cdot 2\ H_2O$, 0.5 g.; iron, 10 mg. in sequesterene solution; distilled water, 10 liters. The pH of the solution was adjusted with 0.01 N hydrochloric acid to 6.00-6.38. To determine the optimum pH for the development of the gemmae, several solutions with pH values between 1.65 and 7.30 were prepared. It was found that the gemmae grew poorly in solutions with pH values under 3.5, but that above this pH the growth did not seem to vary with the acidity. The culture vessels employed were Jena glass petri dishes with covers, which were sterilized before use. The conditions are not sterile, however, since the gemmae cannot be sterilized. Lilienstern (1927) came to the conclusion that there is no advantage in sterile conditions when pure cultures of *Marchantia* are grown in inorganic culture media.

Since the main purpose in the greater part of the experiments was to determine the effect of different parts of the parent plant on the development of the gemmae, a number of preparations were made from the receptacles and undifferentiated thalli which were placed on nutrient agar. Gemmae were placed on these preparations and on agar in the same petri dish. In preliminary experiments it was established that no growth substances were transferred from the inner surfaces of intact receptacles when these were pressed against the agar surface. Receptacles were cut both lengthwise and crosswise and gemmae placed on the emptied halves.

Various parts of the plants were also macerated, and a small amount of nutrient solution was added to give a viscous mass. A thin layer of the mass was evenly spread on the agar and gemmae planted on this surface layer. As far as possible, gemmae of the same size and from the same receptacles were employed in the parallel and control experiments. To maintain constant moisture, the air in the petri dishes was saturated with water vapor in a part of the experiments. Artificial illumination was used throughout. During the last quarter of 1953 the illumination was either rhythmic with 12-hour periods of light and darkness or continuous. Since the gemmae grew best when exposed to continuous light, although the total amount of light energy was the same in both conditions, continued illumination about 40 ft.-candles was employed in the later experiments. The gemmae exposed to alternating light-dark periods were kept at room temperature 18-19°C and the cultures exposed to continued illumination in a thermostat at 21-23°C.

The development of the gemmae was studied with the microscope, paying particular attention to the growth and formation of rhizoids. During each period of observation the maximum lengths in the direction of the growth centers of ten gemmae and their greatest widths perpendicular to the longitudinal axes were measured. The readings of the measuring ocular were not transformed into actual units ($1 = 39\,\mu$) in these measurements, and only relative values are reported. The sizes of the gemmae grown under different experimental conditions were plotted, and the standard deviation (ξ) of the frequency distribution and the standard error (ε) of the arithmetic mean were computed.

The Influence of the Parent Plant in Regulating the Resting Stage in the Gemmae

Gemmae left undisturbed in the receptacles did not germinate during several weeks although the receptacles had been isolated from the thalli and were exposed to strong light on agar. Only after the tissues of the receptacle began to disintegrate did rhizoids appear on the gemmae. It was particularly noted that the cell masses protruding from the receptacles remained ungerminated like those within the receptacles. In those experiments in which all the gemmae were removed from the intact receptacle and ten of them immediately replaced, the latter began to germinate within the receptacle. The development of rhizoids was, in this case, appreciably slower than on agar, for small rhizoids were seen on only half of the gemmae in the second day, whereas the rhizoids on the control gemmae on agar had undergone marked develop-

ment. Also the growth of the gemmae was slower in the receptacle than on agar, but even this growth was not nearly as slow as the development of the rhizoids. When, in other experiments, the emptied receptacles were filled with gemmae, rhizoids developed on only a few of the gemmae, and the growth was very limited. When the upper walls of the receptacles were carefully cut away leaving the gemmae as a uniform mass on the floor of the receptacle, most of the gemmae germinated after two days (*fig.* 3-5). The same results were obtained when the bottoms were removed from the receptacles but the contents were left undisturbed. The influence of the gemmae on each other was studied by making receptacles from paper and filling these with gemmae and by placing clusters of gemmae on the thallus and on agar. Three days later the gemmae in the masses in the artificial receptacles and on agar had begun to grow, and rhizoids were found on almost all of them, whereas no rhizoids or growth was

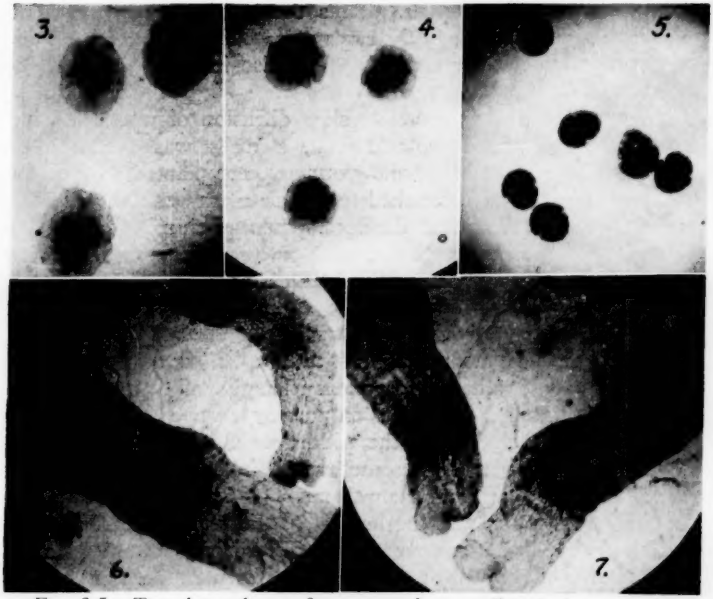


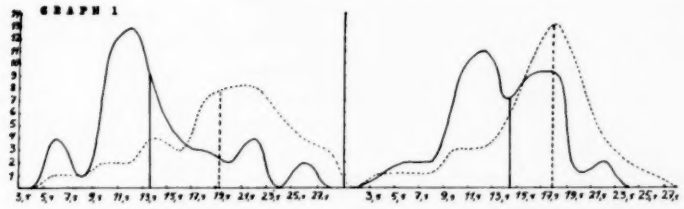
FIG. 3-5. Two-day culture; 3, gemmae from undisturbed receptacle; 4, gemmae from a receptacle from which the wall has been removed; 5, gemmae grown on agar. Ca. × 9. FIG. 6. Six-day-old culture. The smaller gemma grew on crushed receptacle wall mass, the larger one on control agar. Ca. × 22. FIG. 7. Six-day-old culture. The smaller gemma grew on crushed receptacle wall mass, the larger on control agar. Ca. × 22.

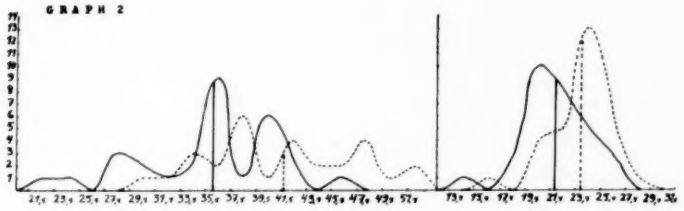
detected in the mass of gemmae placed on the thallus. The probable reason for the inhibition of growth in the latter case was lack of moisture in the thallus substrate since the gemmae began to germinate when a few drops of water were added to the thallus. A mass was also prepared by macerating gemmae; gemmae planted on this mass grew less vigorously than those planted on agar.

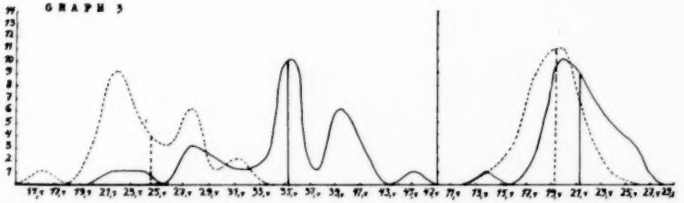
When gemmae were firmly pressed against the walls of longitudinally cut receptacles placed on agar, the inhibiting effect of the receptacle tissues on germination and growth became clearly evident. When gemmae planted on halves of receptacles placed on agar were compared, the development of gemmae varied in different regions of the receptacle wall (*fig.* 2). After three days rhizoids were found on all gemmae in the upper regions of the receptacle but only sporadically in the lower regions. The lengths of the gemmae were less than the widths in the lower areas, whereas in the upper regions the lengths were equal to or greater than the widths (*graph* 1). Thus the growth was only intercalary in the lower areas of the receptacle. After five days rhizoids developed and the gemmae had grown also in the lower areas of the receptacles.

In order to avoid a possible slow diffusion of water and nutrients through the receptacle wall, a mass was prepared by macerating the receptacles, and gemmae were planted to grow on the crushed mass. The crushed receptacle mass was able to inhibit growth but did not prevent the development of rhizoids (*graph* 2). Receptacles were also cut into pieces and parts from the walls and bottoms and also slime from the bottoms were separately worked into masses. After three days the lengths of gemmae grown on the wall, slime and bottom masses varied as $25.7 \pm 3.4 : 27.5 \pm 5.3 : 29.5 \pm 2.6$ and the widths as $17.4 \pm 2.0 : 16.3 \pm 1.5 : 18.4 \pm 1.3$ (*fig.* 6 and 7). The corresponding lengths of control gemmae grown in the same Petri dishes on pure agar varied as $26.5 \pm 3.1 : 31.5 \pm 4.5 : 31.9 \pm 3.9$ and the widths as $18.1 \pm 1.6 : 19.3 \pm 1.9 : 18.4 \pm 1.5$. It seems that some growth-inhibiting substance had passed into the agar from the wall mass. The part with the weakest inhibiting action was the bottom of the receptacle from which the slime had been removed. No difference was noted in the development of rhizoids on the gemmae grown on these masses and on pure agar.

Gemmae placed on undifferentiated thalli germinated at a slower rate than those placed on agar. The uneven development of rhizoids on the former gemmae suggests, however, that one reason for the slower growth was insufficient water. After two







GRAPHS 1-3. Size distribution of the gemmae produced under different growth conditions. The horizontal axis on the left gives the length, that on the right the width, and the vertical axis the frequency. GRAPH 1. Culture three days old; 50 gemmae measured.—Gemmae at the bottom of the receptacle. Mean length 14.1 ± 2.1; standard deviation ± 2.43. Mean width 15.0 ± 1.7; standard deviation ± 2.04.—Gemmae in the upper part of the receptacle. Mean length 18.8 ± 2.2; standard deviation ± 2.53. Mean width 18.5 ± 1.9; standard deviation ± 2.20. Illumination cycle: 12 hours light and 12 hours darkness. GRAPH 2. Culture four days old; 30 gemmae. —Gemmae grown on crushed receptacle mass. Mean length 36.1 ± 3.1; standard deviation ± 2.84. Mean width 21.8 ± 1.5; standard deviation ± 1.36.—Gemmae grown on control agar. Mean length 41.7 ± 3.3; standard deviation ± 3.02. Mean width 23.9 ± 1.6; standard deviation ± 1.40. Continuous illumination night and day. GRAPH 3. Culture four days old; 30 gemmae.—Gemmae grown on crushed receptacle mass. Mean length 36.1 ± 3.1; standard deviation ± 2.84. Mean width 21.8 ± 1.5; standard deviation ± 1.36.—Gemmae grown on crushed thallus mass. Mean length 25.1 ± 2.1; standard deviation ± 1.90. Mean width 19.9 ± 1.2; standard deviation ± 1.13. Continuous illumination day and night.

days the number of gemmae with rhizoids varied in different cultures on thalli from one to nine per ten gemmae. No variation as great as this was noted in the growth of the gemmae. On hard paper (cardboard) which absorbed water poorly, the gemmae grew and germinated similarly to those on the undifferentiated thallus. It seemed, however, that the thallus contained some growth-inhibiting substance, since gemmae grew less well on a mass prepared by macerating undifferentiated thalli than on pure agar. No difference was observed, however, in the development of rhizoids. A comparison of the growth of gemmae on receptacle mass and thallus mass showed that the latter had the greatest growth-inhibiting action (*graph 3*). Control gemmae that grew on agar which was partly covered with thallus mass developed less rapidly than the control gemmae on agar partly covered with receptacle mass. It may hence be concluded that more growth-inhibiting substance is released by undifferentiated thallus mass than by receptacle mass.

The pH of the receptacle mass was 6.28 and that of the undifferentiated thallus mass 6.49, and hence the variation of the growth-inhibiting effect was not due to acidity.

In some experiments the contents of the receptacle were mixed with a needle to detach the gemmae from the plasma contact. A few of the gemmae began to germinate, but the majority did not. The former gemmae later continued to grow, while the latter remained unchanged. It is thus obvious that the growth-inhibiting substance cannot prevent the growth of germinated gemmae (*cf.* Oppenheimer, 1922).

When the experiment carried out by Oppenheimer (*l.c.*) to determine the effect of distilled water and nutrient solution on the growth-inhibiting substance in the receptacle was repeated, results different from Oppenheimer's were obtained. Neither distilled water nor the MS-solution employed was able to influence the action of the growth-inhibiting substance. In contrast, the action of the latter was completely suppressed by adding two drops of a 0.01 per cent β-indolylacetic acid solution to the receptacle. Rhizoids appeared on almost all of the gemmae and the latter began to grow. This growth was, however, slower than that on agar.

Gemmae placed to grow on glass in a moist atmosphere did not germinate. Also when the gemmae were mixed with germinating oats which consumed all the oxygen and stored in a firmly closed vessel in the dark, they did not germinate but turned deep green in color.

Experiments with Growth Substances

Gemmae were also transferred to grow on nutrient agar containing β-indolylacetic acid in concentrations varying from 0.1 to 0.0000001 per cent. The gemmae died almost immediately when the acid concentration was 0.1 per cent. The 0.01 per cent concentration arrested growth and effected contraction of the gemmae. After some time numerous rhizoids appeared on the dorsal sides of the gemmae. Cell division was also retarded so that cells of abnormal size were formed (*fig.* 8). Four side lobes instead of two grew from the constricted gemmae and extended upward from the substrate. The effect of the 0.001 per cent concentration greatly resembled the preceding. Some of the rhizoids contained chloroplasts. The gemmae that grew on agar containing 0.00001 per cent or less β-indolylacetic acid did not differ appreciably from the control gemmae. Dichlorphenoxyacetic and β-naphthoxyacetic acid were similar in their action to β-indolylacetic acid. Thiourea also inhibited the growth in high concentrations, but in contrast to the preceding substances it did not promote the rhizoid development, which took place to the same extent as in the control cultures. The branches of the gemmae grew strongly upward from the 0.01 per cent thiourea solution but their number was the normal two, and not four as in the case of β-indolylacetic acid.

Fig. 8. Twelve-day-old culture grown under the influence of 0.01% indolylacetic acid. Ca. × 50.

Discussion

Substances that prevent germination are found in most plants. These substances are not generally specific and may be located in any part of the plant (Crocker, 1948; Evenari, 1949). The factors promoting and arresting growth are frequently closely related

chemically and readily undergo transformation one to the other (Toole *et al.*, 1956).

Since addition of water to the receptacle does not affect germination and since the air chambers in the walls of the receptacle let air through to the gemmae in the bottom of the receptacle, the non-occurrence of germination is evidently due not to lack of water and oxygen, but to some substance secreted by plant. The non-germination of the gemmae within the receptacle is a special case of a correlation effect of the parent plant. Such an effect does not presuppose the existence of special structures like receptacles, for the inhibition of germination may be caused by a pure correlation effect of the growth centers of the parent plant. This is the case, for instance, with several leaf-bearing Hepaticae (Buch, 1920). Bünning (1953, p. 295) believed that the hormones excreted by the growth centers can hardly be considered auxins since they are not absorbed by agar, but more probably inhibitors of auxins, blastocholines. He assumed also (*l.c.*, p. 70) that the substances preventing germination in the receptacles of *Marchantia* are also blastocholines.

In the present study it was established that the inhibition of germination ends rapidly in *Marchantia*. Germination begins already in the receptacle when gemmae removed from the receptacle are immediately replaced. Even stirring of the contents of the receptable leads to the germination of some, if only a few, of the gemmae. It seems that the inhibiting substance must be able to move freely in the capillaries between the gemmae to exert its effect. It may also be supposed that concentration of the inhibitor diminishes from the bottom upward and that stirring alters the concentration gradient. Evidently the inhibitor readily decomposes or changes and hence when its availability is artificially altered germination is no longer hindered.

The conducted experiments have shown that the walls and especially the lower parts of the receptacle contain substances that inhibit the growth and appearance of rhizoids associated with germination. Since the lower parts of the walls exert a stronger inhibiting action than the upper parts, it seems probable that the inhibitor is secreted from the lower region of the receptacle. It may be assumed that the strong inhibition of germination in the lower part of the receptacle is due to the weak penetration of moisture through the thick layers in this lower part, for it was observed that the undifferentiated thallus was able to inhibit germination because of the slow penetration of water through it. The tissue at the base of the receptacle is, however, much more porous than the leather-like structure of the undifferentiated thallus and

hence a difference in moisture availability cannot explain the inhibition of germination by lower parts of the receptacle. Neither was any irregularity noted in the development of rhizoids on the gemmae in the lower parts of the receptacle that might have been caused by uneven access of moisture, as was seen in the gemmae grown on undifferentiated thallus.

Oppenheimer (1922) did not observe any inhibition of growth in gemmae planted on ground-up receptacles. In the present study in which a larger material was examined the mass prepared by macerating the parent plant was found to prevent the growth of the gemmae, but not the development of rhizoids. It was observed that the mass prepared from undifferentiated thalli had a stronger inhibiting action than the mass prepared from the receptacles. It thus seems that the concentration of the inhibitor is no greater in the receptacle than in the undifferentiated thallus. The mass prepared from the part of the thallus forming the base of the receptacle had only a weak inhibiting action. It might be assumed that the diffusion of inhibitor to the gemmae through the lower part of the receptacle leads to a deficiency of the inhibitor substance in the thallus in this region. The weak correlation effect in this part of the thallus is reflected in the ease with which adventive shoots are formed at this point (Vöchting, 1885). Consequently no inhibitor is excreted by the receptacle itself which thus functions only as a route by which the inhibitor found throughout the plant is released.

A mass prepared by macerating parts of the parent plant had an inhibiting action only on the growth of the gemmae, but not on the second phase of the germination process, the formation of rhizoids. It is, however, the inhibition of rhizoid development that is the essential function of the receptacle. In the experiments with receptacles cut into halves the lower parts of the receptacles were also observed to inhibit the formation of rhizoids. It thus seems that there is some other inhibitor in the receptacle different from that in the undifferentiated thallus. The former inhibitor decomposes so rapidly that its effect rapidly weakens when the receptacles are handled. No effect of this substance is noted after the receptacles have been macerated. Even the emptying of the receptacle is sufficient to prevent, at least in part, the excretion of this substance. It may, of course, be that the substance does not decompose, but is volatile, since also in undisturbed receptacles those gemmae that appear to be loosely located above the receptacle do not germinate.

It is probable that it is this easily decomposed or volatile substance that inhibits the germination of the gemmae within the receptacle. This substance is not absorbed by agar. The present

experiments have shown that a substance that inhibits the growth of gemmae but does not influence the development of rhizoids is released from crushed, but not from intact thalli. Apparently there are two substances in the receptacle that together prevent germination. One of these is evidently distributed over the whole thallus and receptacles, the other is present only in the receptacle. The latter substance is one that counteracts some growth factor, since its action was suppressed by adding a few drops of β-indolylacetic acid to the receptacle, whereupon rhizoids appeared on the gemmae and growth ensued. On the other hand, β-indolylacetic acid solutions of the same concentrations in the substrate outside the receptacle were unable to inhibit the growth of the gemmae. The formation of rhizoids was abnormally luxuriant also in the latter case. The experiments of Fitting (1939) on the effect of β-indolylacetic acid on the germination of the gemmae in the dark suggest that the formation of auxins under the influence of light leads to the germination of the gemmae in nature. Some substance within the receptacle either prevents the formation of auxins or functions as a counter-agent of the latter.

The results obtained in the experiments carried out to determine the effect on the growth of the gemmae of β-indolylacetic, dichlorphenoxyacetic acids in the substrate were very similar to those reported by Rousseau (1950, 1951, 1954a).

SUMMARY

A series of experiments were conducted on *Marchantia polymorpha* to clarify the inhibition of the germination of the gemmae by the parent plant.

Gemmae that were removed and immediately placed back in the receptacle began to germinate there. The growth of the gemmae was, however, much slower in the receptacle than the growth of gemmae planted on nutrient agar.

The lower parts of the walls of the receptacles inhibit the germination, and especially the formation of rhizoids, to a greater extent than the upper parts of the receptacles.

Masses prepared by macerating detached receptacles and undifferentiated thalli inhibited the growth of the gemmae, but they did not have any influence on the development of rhizoids. A growth inhibiting substance thus diffused into the agar from the receptacle and thallus masses.

Addition of a few drops of a β-indolylacetic acid solution to the gemmae in an undisturbed receptacle induced rhizoid formation and growth of the gemmae.

The conclusion was drawn that substances capable of inhibiting the growth of gemmae are present in both the receptacles and undifferentiated thalli. It is, however, probable that some substance that prevents the germination is excreted by the receptacle, but is not present in the thallus.

The author wishes to express her thanks to Professor P. KALLIO, Ph.D., for suggesting the subject of the study and for valuable advice during the course of the experiments.

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THE MOSSES OF NORTH CAROLINA. VII. ADDENDA AND CORRECTIONS[1]

LEWIS E. ANDERSON[2]

ANDREAEA ROTHII Web. & Mohr var. CRASSINERVIA (Bruch) Mönk. This variety was reported from North Carolina, based on poor material in a specimen collected by P. O. Schallert, in 1923, from Moore's Knob, Stokes Co., in the northern upper Piedmont. I have since restudied this specimen and now believe it is *A. rothii*. Also, I have visited Schallert's station and recollected in quantity material identical to that obtained by Schallert. It differs in no way from typical *A. rothii*.

Sharp (MFNA 1: 4. 1936) gave the range of var. *crassinervia* as extending south to Georgia, based apparently upon a specimen collected by John K. Small at Tallulah Falls in 1893 (issued in Small's *Mosses of the Southern United States*, no. 27). We have two specimens of this number in the Duke Herbarium, and I have been unable to distinguish either of them from ordinary *A. rothii*. Likewise, I have seen no other material from the southeastern United States that agrees with var. *crassinervia*.

ATRICHUM MACMILLANI (Holz.) Frye, reported in part III, from North Carolina, is synonymous with *A. angustatum* (Brid.) BSG.

POGONATUM CAPILLARE (Rich.) Brid. continues to be cited in current bryological literature as occurring in North Carolina, but

[1] Part II., Introduction, appeared in THE BRYOLOGIST 41: 1-11. 1938; Part III., Andreaeaceae to Fissidentaceae, 41: 82-90; Part IV., 41: 118-123; Part V., Dicranaceae to Calymperaceae, 42: 62-70; Part VI., Encalyptaceae to Pottiaceae, 54: 145-161. This study was aided by a grant from the Research Council of Duke University and by a grant from The National Science Foundation to Duke University (NSF-G-23-222).

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as far as I am able to determine, it does not occur south of Pennsylvania. As pointed out in part III, the original description by Richard in Michaux's *Flora Borealis Americana* does not suggest a type locality, but Bridel (Bryol. Univ. 2: 128, 1827) is responsible for the statement, "In Americae borealis Carolina detectum," which is the only basis for the record. *P. capillare* is a far northern and high altitude species that would scarcely be expected to grow in North Carolina.

POLYTRICHUM FORMOSUM Hedw. Reported in part III, from three localities, this species has since been collected from a dozen or more additional places. It is a common element of the higher Appalachian spruce-fir forest at altitudes of 6000 feet or more, growing on moist shaded rocks or on humus. The specimens cited below are representative of the additional collections. All the specimens cited possess capsules. No. MTS.: Avery Co., *L.E.A.* 12724; Mitchell Co., *L.E.A.* 13068; Yancey Co., *L.E.A.* 12805. So. MTS.: Jackson Co., *L.E.A.* 10089; Haywood Co., *G. F. Beaven* M362; Buncombe Co., *L.E.A.* 6570; Macon Co., *L.E.A.* 11052.

POLYTRICHUM GRACILE Sm. This species has also been considered rare in the Southern Appalachians. When part III appeared, it was known from only two localities, but since that time it has been collected in several additional areas and is not uncommon above altitudes of 6000 feet. Like *Polytrichum formosum*, *P. gracile* is also associated with spruce-fir but tends to grow in more moist and more shaded situations. Occasionally they have been found together. In addition to those cited in part III, the following stations are known: No. MTS.: Yancey Co., *L.E.A.* 10918, 10994; Avery Co., *L.E.A.* 12819; Mitchell Co., *L.E.A.* 13004. So. MTS.: Jackson Co., *L.E.A.* 10091. Good fruiting specimens have been collected, and the capsules are indistinctly angled, in contrast to the sharply angled capsules of *P. formosum*. The marginal cells of the lamina in *P. gracile* vary enormously. There are seldom less than 5 rows of marginal cells, averaging 16-21 μ in diameter, which is nearly twice the diameter of the cells of *P. formosum*. In moist places at high altitudes a form of *P. gracile* with very few lamellae has been collected; this form is apparently identical to the one described by Braithwaite (Jour. Bot. 1885: 169) as *Catharinea dixoni*, but later (*British Moss Flora* 1: 295. 1887) recognized as a form of *P. gracile*. An exaggerated form of this type occurs on Mt. Mitchell, Yancy Co., in which less than half of the width of the leaf is occupied by lamellae; the leaves are broad in the middle, somewhat ovate-oblong with acute apices and little or no differentiation into leaf base and limb. The broad exposed laminae are transversely undulate and when wet the leaves

tend to be flexuose and patulous. In the field these plants have a remarkable resemblance to *Atrichum undulatum* (Hedw.) Beauv.

POLYTRICHUM PILIFERUM Hedw. On thin soil, granitic rock exposures. No. MTS.: Ashe Co., shallow soil on rock near summit of Johnson's Knob, Big Tree Mt., *D. S. Correll* & *G. W. McDowell* 10855, May 26, 1939; thin soil, exposed rocks, east slope of Bluff Mt., southeast of Creston, *L. E. Anderson* & *E. F. Jones* 9629, Aug. 27, 1950; Alleghany Co., soil, edge of mats, granitic rock exposure, Stone Mt., near Miles, alt., 3800 ft., *L.E.A.* 8208, Aug. 27, 1948; Wilkes Co., thin soil, granitic rock outcrop, Bluff Overlook, Blue Ridge Parkway, *L.E.A.* 7539, June 12, 1948. The collection by Correll and McDowell was the first for North Carolina. It was previously known only as far south as Virginia. All of the collections are sterile but contain well-developed vigorous plants. The leaf apices are hyaline and markedly distinct from those of *P. juniperinum.*

FISSIDENS ANDERSONI Grout. Wet, mucky soil, edge of swamps, rivers or recently inundated places. No. COASTAL PL. Currituck Co., wet soil floor of swamp, near Currituck, *L.E.A.* 6505, May 15, 1939 (TYPE); Pitt Co., moist soil, edge of swamp, 1 mile west of Bethel, *L.E.A.* 6854, May 3, 1940; swampy soil, river bank, near Bethel, *L.E.A.* 6880, May 3, 1940. So. COASTAL PL. Brunswick Co., wet, mucky soil, edge of swamp, south of Shallotte, *L.E.A.* 10855, March 22, 1952. This species is also known from Tennessee (Clebsch, Castanea 19: 1-20. 1954) and Florida (Breen, THE BRYOLOGIST 59: 264-265. 1956).

FISSIDENS EXIGUUS Sull. On rocks, moist shaded places. So. MTS.: Swain Co., moist calcareous rocks, mouth of spring, Blowing Springs, 1½ miles northeast of Hewitt, Nantahala Mts., *L.E.A.* 10152, Aug. 7, 1951. This species was previously reported from North Carolina by Grout (N. A. Flora 15(3): 182. 1943), but I have been unable to locate the specimen upon which Grout based the report. Meanwhile, I collected a small amount of it in the Nantahala Mts. As elsewhere, this species is apparently exceedingly rare in North Carolina. It is not at all unlikely that *F. exiguus* may be confined to calcareous rocks, at least in the Southern Appalachians, which could account for its erratic distribution.

FISSIDENS OBTUSIFOLIUS Wils. Wet, calcareous rocks. So. MTS.: McDowell Co., wet, calcareous rocks, mouth of underground stream, base of vertical limestone cliff, Linville Falls, *L. E. Anderson* & *E. F. Jones* 9729, Apr. 27, 1951. Although North Carolina is well within the range of this small and variable species, this collection is the first from the state. It was found on lime-

stone, near the waterline at the mouth of an underground stream that flows from an intricate system of caves. The leaves are indistinctly bordered at the base and are quite obtuse.

FISSIDENS POLYPODIOIDES Hedw. Limestone ledges and calcareous rocks edge of streams. So. MTS.: McDowell Co., moist shaded ledges, limestone cliff, above Linville Caverns, south of Linville Falls, *L. E. Anderson* & *R. K. Godfrey* 9831, June 4, 1951; moist calcareous rocks, along stream, John's Creek, north of Marion, *L.E.A.* 9851, June 5, 1951. There are no previous records of this species from North Carolina. The plants are smaller than average, and the leaves are somewhat more denticulate and acute at the apex than usual.

FISSIDENS ADIANTOIDES Hedw. var. SEMICRISTATUS Grout is synonymous with *F. cristatus* Wils. (see Anderson & Bryan, Rev. Bryol. et Lichénol. 25: 254-267. 1956).

ARCHIDIUM DONNELLII Aust. Sandy soil, old fields. So. COASTAL PL.: Cumberland Co., sandy soil, old field, 14 miles north of Fayetteville, *L.E.A.* 6146, March 20, 1938; Harnett Co., sandy soil, among grasses, old field, near Erwin, *L.E.A.* 6146, March 20, 1938. These records are the first for North Carolina, although the species ranges along the Atlantic Coastal Plan, from Maryland to Florida. As it turns out, this is our most distinctive species. The plants are conspicuously capitate, a feature easily observed in the field, and the entirely smooth spores readily distinguish it from *A. hallii.*

ARCHIDIUM FLORIDANUM Aust. Sandy soil, old fields. So. COASTAL PL.: Cumberland Co., sandy soil, old field, 14 miles north of Fayetteville, *L.E.A.* 6144, March 20, 1938. This collection represents a remarkable extension of the known range of this rare species. There seems to be little question as to its identity, if the distinctions between it and *A. ohioense* Schimp. are valid. The spores of the North Carolina material of *A. floridanum* are more than 200 μ in diameter (*A. ohioense:* 145-175 μ), the leaves are narrowly lanceolate, averaging more than 1 mm. in length (*A. ohioense:* lanceolate-subulate, less than 1 mm. long), and the entire plants measure between 1.5 and 2 cm. high (*A. ohioense:* less than 1 cm. high). The plants of *A. floridanum* grew in the same field adjacent to but not intermingled with *A. donnellii.* The two species, as they occur here, are easily distinguished, however. The latter is not noticeably capitate, while the antheridia in *A. floridanum* are produced in bud-like clusters surrounded with small ecostate perigonial leaves. In *A. donnellii,* the antheridia are terminal on a special branch, surrounded by costate perigonial leaves.

It must be admitted that the distinctions between *A. floridanum*

and *A. ohioense* are entirely quantitative. In a genus in which the species are as infrequently collected as in *Archidium* the distinctions are obviously based on relatively few specimens. Quantitative distinctions often merge when a more representative series of collections accumulate. Final conclusions regarding the distinctions of *A. floridanum,* therefore, must await further collecting.

DITRICHUM CURRITUCKI Grout. Sandy soil, roadbanks, swamp margins. NO. COAST. PL.: Currituck Co., on sandy soil, road bank, near Currituck, *L. E. Anderson* & *A. J. Grout,* May 13, 1939 (TYPE); Dare Co., sandy soil, edge of swamp, 8 miles west of Stumpy Point, *L.E.A.* 4659, Oct. 10, 1936; Northampton Co., sandy soil, edge of swamp, 2 miles east of Jackson, *L.E.A.* 5681, May 8, 1937. SO. COAST. PL.: Columbus Co., sandy soil, edge of swamp, 2 miles east of Longwood, *L.E.A.* Cyt. 342, Feb. 28, 1954; Sampson Co., sandy soil, edge of gum swamp, between Salemburg and Autryville, *L. E. Anderson* & *V. S. Bryan* Cyt. 280. This species is now known in the Coastal Plain from North Carolina, south to Florida, and west to Arkansas. (For a discussion of this species and the next, see Anderson & Bryan, Brittonia 10: 121-137. 1958.)

DITRICHUM HENRYI Crum & Anderson. On soil, in various situations, both open and shaded habitats. SO. MTS.: Jackson Co., on clay soil, road-cut, 2400 ft. alt., Upper Falls, Whitewater River, *L. E. Anderson* & *Henry Wright* 10014, June 7, 1951 (TYPE); Macon Co., clayey soil, road-cut, side of Whiteside Mt., *L.E.A.* 12749.

BRYOXIPHIUM NORVEGICUM (Brid.) Mitt. On boulders and ledges, especially beneath undercut rocks over swiftly moving water. NO. MTS.: Burke Co., *Anderson* & *Jones* 9271. SO. MTS.: Clay Co., *Anderson* & *Wilbur* 8090; Graham Co., *Anderson* & *Wilbur* 8185; Henderson Co., *L.E.A.* 9151; Jackson Co., *L.E.A.* 8627, 8654; Macon Co., *Sharp* & *Bold* 38120 (TENN), *Sharp* 38120, *L.E.A.* 8565; McDowell Co., *Anderson* & *Oosting* 7368; Transylvania Co., *L.E.A.* 8453, 9020, 9043. At the time of publication of part IV, only a single station for *B. norvegicum* was known for North Carolina, represented by a collection by A. J. Sharp, along the Chattooga River, in Macon Co. With more intensive collecting, however, it turns out to be a not uncommon plant in the Escarpment gorges, where it grows characteristically on the underside of boulders next to water. I have not found it north of Linville Gorge. For a more detailed discussion of its distribution, see Löve and Löve (THE BRYOLOGIST 56: 73-94, 183-203. 1953).

BLINDIA ACUTA (Hedw.) BSG. On wet substrates, usually

rocks or boulders in shaded places near streams, or at the base of vertical cliffs, especially near waterfalls. No. Mts.: Yancey Co., *Anderson & Jones 9736*; So. Mts.: Jackson Co., *L.E.A.* 3249, 6622, 8764, 9974, 10128, 10352; Macon Co., *L.E.A.* 10320, 10333. Known only from a single collection when part IV was published, this species has since proved to be frequent in the southern mountains. On several occasions I have collected it in association with *Grimmia apocarpa* var. *gracilis, Amphidium mougeotii* and *Gymnostomum aeruginosum*.

Oreoweisia serrulata (Funck) DeNot. Moist shaded ledges, mainly confined to calcareous rocks. So. Mts.: Macon Co., moist ledge, near waterfall, Cullasaja Gorge, above High Falls, west of Highlands, *L.E.A.* 12837, June 24, 1957. McDowell Co., semi-shaded, ledges, south-facing vertical limestone cliff, Linville Caverns, south of Linville Falls, *Anderson & Jones* 9709, Apr. 27, 1951. This moss is previously unreported from North Carolina. The second locality cited represents the only station where it occurs in some abundance forming extensive tufts in the more moist and shaded ledges.

Cnestrum schisti (BSG) Hagen. (*Oncophorus schisti* BSG; *Cynodontium schisti* Lindb.) Weathered rocks, apparently non-calcareous. So. Mts.: McDowell Co., on weathered rocks, semi-shaded bluffs above a marshy flat, 3 miles south of Woodlawn, *L.E.A.* 9677, Apr. 27, 1951. This collection represents a remarkable occurrence of a moss that is known otherwise in eastern North America only from northern Michigan. According to Grout (MFNA 1: 69. 1936), it ranges from Montana and Wyoming to Alaska, "on soil near rocks and in crevices in moist cool places at high altitudes and latitudes." It is rare in northern Europe, and according to Mårtensson (K. Sv. Vedensk. Avhandl. Natursky. no. 14, p. 61. 1956), "occurs mainly in the conifer belt in Fennoscandia. In the Scandes it is rare in the subalpine belt (at least on the Swedish side)." The North Carolina collection came from the base of the Blue Ridge Escarpment, where the altitude is approximately 1,000 feet; this location would in no way suggest a high altitude or high latitude habitat. Although collected in small quantity, the plants are well developed and in excellent fruiting condition. There can scarcely be any doubt as to its identity, and I am grateful to Mr. E. B. Bartram for confirming the determination.

Associated with *C. schisti* were *Anomodon attenuatus, Fissidens bryoides, F. viridulus, Mniobryum wahlenbergii* and the hepatic, *Plagiochila sharpii*.

Arctoa fulvella (Dicks.) BSG. This species was reported

from the state, in part V, from a collection made by A. J. Sharp, near Toxaway Falls, Transylvania Co., in 1933. Howard Crum and I have since restudied the specimen and find that it is unmistakably *Campylopus tallulensis*. The southernmost known locality for *A. fulvella* is, I believe, the Adirondacks of New York.

BROTHERA LEANA (Sull.) C. M. Decaying wood. So. Mts.: Jackson Co., base of walnut tree, steep bluff, Cedar Cliff Mt., East Fork, Tuckaseegee River, *L.E.A.* 9973, June 5, 1951. McDowell Co., on stump, stream bank, mixed mesophytic forest, Escarpment cove, 8 miles north of Old Fort, *Anderson* & *Oosting* 7380, June 11, 1948. Apparently this is not an uncommon moss in Tennessee, but unless it has been overlooked it is not common in North Carolina. It is known also from Virginia (Patterson, THE BRYOLOGIST 58: 215-225. 1955), and I have collected it in South Carolina.

SYRRHOPODON FLORIDANUS Sull. Base of trees, decaying wood, especially near swamps. So. Coast. Pl.: Brunswick Co., bark, base of hardwood, Smith's Island (Baldy), offshore from Southport, *L.E.A.* 6804, August 23, 1939; decaying wood, swamp margin, same locality, *L.E.A.* 6807. These collections were made shortly after the publication of part IV, but are the only records of this species from the state, although it ranges north to Long Island. Smith's Island (locally known as Baldy) is of considerable interest floristically. It is the northern limit of the *Sabal palmetto*, for example, and for several tropical bryophytes.

DIPHYSCIUM CUMBERLANDIANUM Harvill. Shaded rocks, usually with a thin layer of soil, and generally near streams. Three collections of this moss were reported from North Carolina in a separate note (Anderson, THE BRYOLOGIST 55: 127-128. 1952). The following collections are in addition to those previously published. So. Mts.: Macon Co., *L.E.A.* 12996; Transylvania Co., *L.E.A.* 11124, 11073, 12896, 13031. This species is frequent and abundant in the Escarpment gorges, where it grows in cool moist shaded places, usually near water. It is easily recognized in the field by the large size of the plants and by the characteristic brownish-red color. I have not collected *D. cumberlandianum* except in deep river gorges.

ANOECTANGIUM EUCHLORON (Schwaegr.) Mitt. This species was listed from North Carolina in part IV, based on specimens collected by Sharp at Dry Falls, near Highlands, in Macon Co. (see Sharp, Castanea 3: 9-11. 1938). All of the plants determined as *Anoectangium euchloron*, however, are apparently *Gymnostomum aeruginosum* Sm. (see Crum & Anderson, Jour. Elisha Mitchell Sci. Soc. 72: 276-291. 1956). *Anoectangium euchloron*

is therefore at present excluded from the flora of the Southern Appalachians.

ANOECTANGIUM PECKII Sull. Under overhanging rocks. So. MTS.: Jackson Co., moist rock ledge, by waterfall, Lower Rock Bridge, above Bonas Defeat, East Fork, Tuckaseegee River, *L.E.A.* 10590; moist rocks, deeply undercut cliff, same, 10597; moist underside of overhanging rock ledge, same, 10619; Aug. 23, 1951. This rare moss, known previously only from the Catskill Mts. in New York and from the Great Smokies in Tennessee was collected in considerable quantity in a small area that has since been impounded by water from a power dam. All three collections, incidentally, are mixed with *Amphidium mougeotii*, which has a surprising resemblance to *A. peckii*. I am indebted to Harold Robinson for discovering this admixture which had at various times caused me some puzzlement. The North Carolina material is smaller than that from Tennessee (Verdoorn, *Musci Selecti et Critici* 107; Grout, *North American Musci Perfecti* 254) and has narrower leaves which are less abruptly narrowed to the sharp slender point. The leaf outline in our material is somewhat like that of *A. compactum*, and Grout (MFNA 1: 149. 1937) is certainly correct in regarding the two species as close relatives.

ASTOMUM LUDOVICIANUM Sull. Soil among grasses, disturbed areas. NO. PIEDMONT: Durham Co., soil bottomland, disturbed, partially wooded area, along Eno River, 8 miles north of Durham, *Anderson* & *Bryan* Cyt. 247, Jan. 8, 1955. This species was discovered in the state in connection with Dr. Virginia S. Bryan's studies on the cytology of cleistocarpous mosses (THE BRYOLOGIST 59: 118-129. 1956).

HYMENOSTOMUM MICROSTOMUM (Hedw.) R. Br. Bare clayey soil, recently disturbed. NO. PIEDMONT: Durham Co., bare clayey soil, recent fill, partially shaded margin of bottomland, along Eno River, 8 miles north of Durham, *Anderson* & *Bryan* 12601, Jan. 8, 1955. This species is apparently rare in North America. Grout listed it only from Massachusetts, New Jersey and Ohio, based on Andrews' classical studies of this group (THE BRYOLOGIST 27: 1-3. 1924). Virginia Bryan and I made a single collection of this species only a few paces from the place where the aforementioned *Astomum ludovicianum* was discovered. Unfortunately, the capsules of *Hymenostomum microstomum* were too old for meiotic studies, and so we were unable to make chromosome counts. The collection, however, represents a remarkable addition to our moss flora. The capsules were in excellent condition for taxonomic study, showing the characteristic pale membrane which covers the orifice of the capsules. The capsule tapers distinctively toward the

mouth, which is smaller than in *Weissia controversa* Hedw., and when dry the capsules of *H. microstomum* are peculiarly contracted below the mouth. In the North Carolina material, the leaves are somewhat broader than in *Weissia controversa,* and the costa is excurrent into a longer mucro.

HYMENOSTOMUM TORTILE (Schwaegr.) BSG. Calcareous rocks. So. MTS.: McDowell Co., dry exposed limestone ledges, south-facing bluff, Linville Caverns, south of Linville Falls, *L.E.A.* 9707, April 27, 1951. While not absolutely certain that these plants belong with *H. tortile,* they are certainly identical with Sharp's collections from Tennessee that have been referred to this species (Amer. Midl. Nat. 21: 267-354. 1939). While studying Ozark mosses, Howard Crum and I had occasion to compare collections from the Appalachians, Ozarks and Southwest, and there are puzzling differences among these collections, especially in the nature of the papillae as revealed in leaf cross-sections. It is a problem that we intend to study in more detail, but in the meantime I am referring the North Carolina plants to *H. tortile.*

GYMNOSTOMUM CALCAREUM Nees & Hornsch. The several collections of this species reported from North Carolina in part VI have since been redetermined as *Gymnostomum aeruginosum* Sm. (see Crum & Anderson, *l.c.*)

EUCLADIUM VERTICILLATUM (Brid.) BSG. Moist calcareous rocks. So. MTS.: McDowell Co., moist, limestone ledges, partially shaded cliff, Linville Caverns, south of Linville Falls, *L.E.A.* 9710, Apr. 27, 1951. This species, previously unreported from the state, was discovered shortly after part VI was published. It has been reported from Tennessee and Virginia and was to be expected in North Carolina. It grew in association with *Gymnostomum aeruginosum, Hyophila tortula* (Schw.) Hampe, *Encalypta streptocarpa* Hedw., *Didymodon recurvirostris* (Hedw.) Jenn. and the fern, *Asplenium cryptolepis* Fernald.

MOLENDOA SENDTNERIANA (BSG) Limpr. Calcareous rocks. So. MTS.: McDowell Co., limestone crevices, vertical cliff, deep gorge, along North Fork, Linville Caverns, south of Linville Falls, *Anderson & Jones* 9585, Aug. 26, 1950; moist, shaded limestone ledges, high vertical cliff, above Linville Caverns, south of Linville Falls, *Anderson & Jones* 9705, Aug. 27, 1951. So. COAST. PL.: Jones Co., marl outcrop, shaded ravine, along Trent River, northeast of Pollocksville, *L.E.A.* 9813, Aug. 27, 1951. The remarkable discovery of this species in North America must be credited to Sharp and Iwatsuki (*unpublished*), who first discovered it in Tennessee. Because if its close resemblance to the common and widespread *Trichostomum cylindricum,* it had been overlooked in

the U.S. I had previously misnamed all of the above collections from North Carolina as that species, and I am indebted to both Sharp and Iwatsuki for the correct identifications.

The occurrence of *Molendoa sendtneriana* on the Coastal Plain is somewhat surprising, although the area in which it grows is an unusual one from a vegetational point of view. The area was called to my attention by Dr. A. E. Radford, University of North Carolina, who has studied the vascular plants of the area. Densely wooded with an overstory of oaks, hickories and beech, the terrain is dissected with small streams that have produced several small ravines whose banks have scattered outcrops of marl. These outcrops are rich in bryophytes whose greatest abundance is in the Mountains, *e.g., Taxiphyllum geophilum* (Aust.) Fleisch., *Bryhnia graminicolor* (Brid.) Grout and *Porotrichum alleghaniense* (C. M.) Grout. *Molendoa sendtneriana* was collected in association with these mosses and with *Weissia controversa, Anthoceros laevis* L. and *Rhodobryum roseum* (BSG) Limpr.

TORTULA FRAGILIS Tayl. Rocks and trees, according to Steere (MFNA 1: 235. 1939). So. Mts.: Jackson Co., shaded rock cliff, Cedar Cliff Mt., East Fork, Tuckaseegee River, *L.E.A.* 9899, June 5, 1951. Previously unreported from North Carolina, the known range of this species is extended southward from southern Virginia. It grew in association with *Weissia controversa, Tortella humilis* (Hedw.) Jenn., *Fabronia ciliaris* (Brid.) Brid. and *Frullania brittoniae* Evans.

MERCEYA LIGULATA (Spruce) Schimp. Moist shaded rocks. So. Mts.: Jackson Co., dry vertical rocks, among cedars and shortleaf pine, Cedar Cliff Mt., East Fork, Tuckaseegee River, *L.E.A.* 9959, June 6, 1951; McDowell Co., calcareous rocks, dry ledges above Linville Caverns, south of Linville Falls, *Anderson & Jones* 9683, Apr. 27, 1951; Swain Co., bluffs along Hwy. N. C. 28, south of Bryson City, near Macon Co. line, *A. J. Sharp* NC541, Aug. 29, 1954. The McDowell Co. specimen contains depauperate and poorly developed plants in contrast to the other collections. Sharp's collection is exceptionally well developed. The plants apparently grew in large thick cushions up to 4 cm. deep.

(To be continued)

THE BRYOPHYTE FLORA OF MT. MCKINLEY NATIONAL PARK, ALASKA

HERMAN PERSSON AND WILLIAM A. WEBER[1]

Mt. McKinley National Park should ultimately become one of the most intensively explored areas in Alaska because of its great scenic interest and its increasing accessibility to tourists and amateur botanists. Its moss flora has been published fragmentarily from time to time by various authors, the latest publication dealing almost entirely with the Park being that of Sherrard (1957). Numerous papers by Persson, Persson and Gjaerevoll, Harvill and others include references to McKinley Park mosses, but there is no single work in which all of these records are brought together.

Although the moss flora of Mt. McKinley Park is still only slightly known, if one considers the small territory which has been intensively explored as yet, it seems desirable to publish a working basis for the use of future students who will certainly reach the Park in increasing numbers during the next few years. The large collections of bryophytes, lichens and angiosperms collected in 1956 by Weber and Viereck in connection with Viereck's study[2] of the Muldrow Glacier moraine are extensive enough and fill so many gaps in our records that this procedure seems justified at this time.

Sherrard has given an account of the Park and its terrain, and Viereck will present detailed ecological discussions later. The present paper is confined to an annotated list of the bryophyte flora with special reference to collections made by Weber and Viereck.

The 1956 collections were made chiefly in the vicinity of Mount Eielson, on the south side of Thoroughfare River east of Muldrow Glacier, and in the Wonder Lake region. In the cause of brevity, the localities are not given in full in the citations; they are described in detail in this introduction. Collection numbers are those of Weber and Viereck (*W*) or Viereck (*V*) unless otherwise stated. The principal collection is in the University of Colorado Herbarium, a duplicate set is at the Naturhistoriska Riksmuseet, Stockholm, and several thousand replicate packets have been distributed to major herbaria throughout the world.

Future students should note that certain areas in the Park have hardly been sampled. The Wonder Lake region is perhaps best known, yet even here the collecting can hardly be called in-

[1] Paleobotaniska Avdelningen, Naturhistoriska Riksmuseum, Stockholm, and University of Colorado Museum, Boulder.

[2] National Science Foundation, Project G 2487: Ecology of certain areas in the Alaska Range; Arctic Institute of N. America Project No. 20: An ecological study of plant communities in the Alaska Range.

tensive. The Mount Eielson region is also well collected, but future visitors may see species which have been missed. The eastern end of the Park, even along the highway, is very poorly collected, and the hinterland is bryologically quite unknown.

One area should be emphasized as particularly interesting to bryologists. This is the Kantishna area, which lies north of Wonder Lake just outside of the Park boundary. Here Sherrard found the remarkable disjunct, *Gollania densepinnata* (Sherrard 1957; Ando *et al.*, 1957), and several other rare mosses such as *Blindia polaris, Pohlia columbica* and *Tetraplodon urceolatus*. Kantishna is an unglaciated area which undoubtedly will yield many exciting finds for some time to come, and it is probable that some of these may be found along Moose Creek inside the Park boundary.

In the summer of 1957 Professor H. T. Shacklette of Georgetown College, Georgetown, Kentucky, accompanied as botanist the Geochemical Exploration Section, Branch of Alaskan Geology, U. S. Geological Survey, in their field work in various parts of Alaska. Pursuant to a request from the senior author to the Survey, Prof. Shacklette made a large collection of bryophytes which are now being studied by the senior author. The results of this study will be published later, but as Shacklette spent August 15-28 in the Mt. McKinley area, collecting mostly at Kantishna but one day also at Stoney Creek in the Park, some of his best finds are included here. He collected 11 bryophytes not previously found in the region; these include, among others, *Cinclidium arcticum, Encalypta affinis, Habrodon leucotrichus* and *Pohlia crudoides*.

A note of phytogeographic interest may be added. In 1957 Persson and Gjaerevoll stated the striking fact that of 184 bryophytes reported by them (mostly from an area northeast of Fairbanks in Centr. Yukon R. and a few from Alaska Range) only 13 did not occur in Scandinavia. If the species found only in the Alaska Range are taken away, the figures are 179 and 12; *i.e.*, only 6.7% of the species do not occur in Scandinavia; of the vascular plants collected by Gjaerevoll in the same areas about 66% do not occur in Scandinavia. It is of interest to compare these figures with those found among the bryophytes of the Mt. McKinley region. No less than 285 species are known from there, but only 18 of them do not occur in Scandinavia. This is an even lower percentage than in the areas mentioned above, namely 6.3%. The reason is that the coastal flora where the bryophyte endemics (including the Amphi-Pacific element) are mostly to be found has very few representatives in the Mt. McKinley region (notably *Macrodiplophyllum plicatum, Oligotrichum aligerum* and *Ortho-*

trichum consimile) and that rather few arctic elements are represented in the collections (for example, *Aulacomnium acuminatum, Blindia polaris, Bryobrittonia pellucida, Cinclidium arcticum, Hygrohypnum norvegicum, Tetraplodon paradoxus* and *Trichostomum cuspidatissimum*). It is suspected that when the highest parts of the region are better studied the representation of arctic elements will increase.

Special thanks are given to Mr. and Mrs. Les A. Viereck and Dr. John Marr, of the Institute of Arctic and Alpine Research of the University of Colorado, who invited the junior author to make collections in the study area, and also to the National Science Foundation and the Arctic Institute of North America for providing travel funds.

Description of Collecting Stations

Mt. Eielson: Moist tundra, fell-field, knife-edge ridge, NW. slope to summit of Mt. Eielson (Copper Mountain), 3500-5500 ft. alt., 63° 25′ N. Lat., 50° 20′ W. Long. The benches on the north side of the mountain just south of Thoroughfare River and the slope and steep-sided ravine just behind the prospect cabin were most thoroughly covered. Good collections were also made during an ascent of the west summit of Mt. Eielson by a route which traversed the northwest slope.

Thoroughfare River: Tundra benches of Thoroughfare River to gravel bars of Glacier Creek, base of Mt. Eielson, ca. 3400 ft. alt., 63° 25′ N. Lat., 150° 25′ W. Long. Both the gravel bars and the high benches surrounding a cove between Mt. Eielson and Glacier Creek, on the south bank of the river, were explored for bryophytes.

McKinley Bar: Mossy spruce forest on gravel bar, north bank of McKinley River south of Wonder Lake, 1800 ft. alt., 63° 25′ N. Lat., 150° 55′ W. Long. Collections were made in the vicinity of the trail leading from Wonder Lake campground and the site of the McKinley Bar cabin, recently burned.

Wonder Lake: Ca. 1800 ft. alt., 63° 28′ N., 150° 55′ W. Most collections were made along the boggy southwest shore of the lake, but a few were obtained on the gravelly, boulder-edged northwest shore.

Muldrow Glacier: Most collections were made by Viereck on the moraine adjacent to the junction of Glacier Creek and Thoroughfare River, ca. 3000 ft. alt., 63° 24′ N., 150° 25′ W. A few were obtained at the junction of the Muldrow Glacier and the glacier from Anderson Pass, 4000-5000 ft., 63° 18′ N., 150° 18′ W., and at the terminus of the moraine along McKinley River, 63° 24′ N. Lat., 150° 32′ W.

A few localities not in the Park proper are cited in the list since it is probable that the species mentioned will eventually be found within the Park boundaries. These localities are Kahiltna Glacier, Kantishna, Lake Chelatna and West Fork Glacier along the Susitna River. Kahiltna Glacier: Moraine and river bars at the terminus of the Kahiltna Glacier, 1000 ft. alt., 62° 28′ N., 151° 15′ W., 27-28 June 1956, *Viereck*. Lake Chelatna: 1500 ft. alt., 62° 25′ N., 151° 25′ W., 21-24 June 1956, *Viereck*.

Determinations were done independently by the junior author, but the entire collection was checked by the senior author. The citations of specimens and brief notes on ecology are the responsibility of the junior author,

while critical comments and detailed nomenclatural discussions are to be credited to the senior author. However, the paper as a whole was assembled by both authors in close collaboration during the junior author's residence at Stockholm's Riksmuseet in 1957-58.

The bryophytes enumerated below total 285 species, including 208 mosses, 17 peat mosses and 61 liverworts; of these, Weber and Viereck collected 149, 14 and 45, respectively. Three species (*Gymnomitrium apiculatum, Marsupella commutata* and *Tortella inclinata*) are new to America. Eleven are new to Alaska, namely: *Cephaloziella arctica, Dichelyma uncinatum, Fossombronia* sp., *Hygrohypnum cochlearifolium, Kiaeria falcata, Lescuraea saxicola, Lophocolea minor, Plagiobryum demissum, Pohlia vexans, Tayloria froelichiana* and *Tritomaria scitula.*

Hepaticae

Anthelia julacea (L.) Dum. Wonder L. with *Pleuroclada albescens* (Sherrard, 1957).

Anthelia juratzkana (Limpr.) Trev. Thoroughfare R., on bare soil of late snow areas, *W* 10171. The finding of this species illustrates how little we still know about the distribution of bryophytes in Alaska-Yukon. It was reported only from some islands in the Aleutians and Bering Sea when Gjaerevoll in 1953 collected it at its first inland locality, Centr. Yukon R. (Persson & Gjaerevoll, 1957). On the other hand, the statement (*l.c.*) that "it is evident that the genus *Anthelia* is sparingly represented in districts with continental climate" is controverted somewhat by the abundance of this species in the Rocky Mountains of Colorado, where it is a ubiquitous late snow-bed species (Weber, unpublished).

Barbilophozia barbata (Schmid.) Dum. Thoroughfare R., *W* 10031; Kahiltna Glacier, *V* 1062.

Barbilophozia hatcheri (Evans) Loeske. Kahiltna Glacier, gravel bar, under *Picea glauca, V* 1062A. In 1947 this species was reported as new to Alaska-Yukon, from E. Pacific Coast, Centr. Yukon R. and Bering Strait (Persson, 1947).

Barbilophozia lycopodioides (Wallr.) Loeske. Mt. Eielson, with *Hylocomium pyrenaicum, W* 10292A.

Blasia pusilla L. Kantishna, on sandy bank formed by flood water (Sherrard, 1957).

Blepharostoma trichophyllum (L.) Dum. Carlo, Kantishna, Wonder L. (Sherrard, 1957); Thoroughfare R., *W* 10073, 10074.

Calypogeia sphagnicola (Arn. & Perss.) Warnst. & Loeske. McKinley Park, with *Sphagnum fuscum, Lepage* 22098 (Persson, 1952a).

Cephalozia ambigua Mass. Kantishna (Sherrard, 1957); Thoroughfare R., with *Sphenolobus minutus, W* 10068, 10075.

Cephalozia bicuspidata (L.) Dum. Wonder L. in deep moist depressions between tussocks, *W* 10322.

Cephalozia connivens (Dicks.) Lindb. Wonder L., exposed on bank of pothole (Sherrard, 1957).

Cephalozia pleniceps (Aust.) Lindb. Kantishna, on mud and stones of creek bed (Sherrard, 1957); Mt. McKinley Park, *Mexia* (Persson, 1952a); Thoroughfare R., with *Mannia pilosa, W* 10039 p.p.; Mt. Eielson, with *Lophozia incisa*, on underhangs of tundra creep terraces, *W* 10253A.

Cephaloziella arctica Bryhn & Douin (*C. alpina* Douin; *C. lorentziana* Douin). Thoroughfare R., in drying tundra pool with *Lophozia wenzelii, W* 10160A; Kahiltna Glacier, on gravel bar, with *Grimmia, V* 1063b *p.p.*

New to Alaska-Yukon. Schuster (1953), who reports it from one locality each in Minnesota and Michigan, states that the range is "only imperfectly known in North America. The form appears to be a strongly Subalpine-subarctic to Arctic-alpine type."

CEPHALOZIELLA DIVARICATA (Franc) Schiffn. [*C. byssacea* (Roth) Warnst.]. Thoroughfare R., in moss tufts, with *Sphenolobus saxicola* and *Dicranum elongatum*, *W* 10072.

CEPHALOZIELLA SUBDENTATA Warnst. [*C. striatula* (C. Jens.) Douin]. Zone of high brush tundra along Park highway between Mile 70 and 80, 2800 ft., 63° 26′ N., 150° 30-45′ W., *V* 1104.

CHANDONANTHUS SETIFORMIS (Ehrh.) Mitt. [*Temnoma setiforme* (Ehrh.) Howe]. Carlo (Sherrard, 1957); Mt. Eielson, *W* 10270, *V* 1175; Kahiltna Glacier, *V* 1063A.

DIPLOPHYLLUM TAXIFOLIUM var. MACROSTICTA Buch. Mt Eielson, with *Hypnum subplicatile* and *Isopterygium pulchellum*, *W* 10289 *p.p.*

FOSSOMBRONIA sp. McKinley Bar, on gravel of a small open frost boil in tundra between Wonder Lake campground and the beginning of the trail to the McKinley Bar Cabin (burned in 1956), *W* 10359. Unfortunately this material, though well developed and unmistakably belonging to *Fossombronia*, is sterile. The genus has not been reported previously from Alaska.

GYMNOCOLEA INFLATA (Huds.) Dum. McKinley Bar, forming a floating mat in small pools among tussocks, *W* 10334; Polychrome Pass, on rock outcrops of alpine slope, with *Conostomum boreale* (Sherrard, 1957).

GYMNOMITRION APICULATUM (Schiffn.) Jörg. [*Marsupella apiculata* Schiffn. Österr. Bot. Zeitschr. 10(53): 249. 1903; *Cesia condensata* Lindb. Musc. Scand. 9. 1879 (*non tamen Gymnomitrium condensatum* Ångstr.); *Marsupella condensata* Lindb. Medd. Soc. F. Fl. Fenn. 13: 238. 1886.] Mt. Eielson, on bare snow-flush areas on shoulder of NW. slope of the mountain where this and *G. concinnatum* cover large areas, *W* 10241. New to North America; I have also named a specimen from E. Pacific Coast: Yakobi Island, mountain west of Little Lake Takanis, on bare gabbro rock, alpine meadow by edge of gracier, ca. 2150 ft., 16.6.1957, *Shacklette* 3948. DISTRIBUTION: Northernmost Europe, Scotland, the Alps, N. Zemlya, Siberia, Greenland. This is a true mountain hepatic, in the Alps found up to 2740 m. alt., growing "mainly in non-calcareous, late snow areas or similar habitats. It may be found in carpets, which are rather free from other bryophytes, but generally it occurs with *Anthelia juratzkana*, *Cephalozia ambigua*, *Gymnocolea inflata*, *Lophozia alpestris*, *L. wenzelii*, *Marsupella condensata*, *M. varians*, *Pleuroclada albescens*, etc. *M. apiculata* is an almost continuously seen species when one examines various samples from late snow areas. It seems to be completely absent when the substratum is calcareous" (Mårtensson, 1955).

Gymnomitrion apiculatum resembles *G. concinnatum* but is generally dark brownish-red. It is 0.5 to 2.0 cm. long, 0.2-0.25 mm. wide. The leaves are bilobed to ⅓. Characteristic are their lobes, which end in an incurved point consisting of 1 to 2 frequently hyaline cells. The marginal cells of the leaves are frequently hyaline.

Gymnomitrion apiculatum can also be reported for the first time from Japan. Dr. Sinske Hattori recently wrote the senior author that he collected it on Mt. Ontake in central Japan, Aug. 24-28, 1951, and has made several collections on high mountains other than Mt. Ontake. It seems to be rare and restricted to the zone above the subalpine coniferous forest in Japan.

GYMNOMITRION CONCINNATUM Corda. Mt. Eielson, on slope of a late snow area, extremely abundant and completely covering the ground, with *G. apiculatum*, *W* 10265; on knife-edge ridge, *W* 10241 *p.p.* This has been reported only once from Alaska-Yukon, from the Chilcoot region in E. Pacific Coast (Stephani, 1887). I have named specimens from Centr. Pacific Coast: Chugach Mts., 1948, *Lepage* 22505; Aleutian Islands; Unalaska I., 1932, Hultén (*Potentilla villosa*) and Lower Yukon R.: Mission Creek, Russian Mts., 2000 ft., 1944, *Stewart* (*Antennaria arctica*, *Macrodiplophyllum imbricatum*, etc.).

GYMNOMITRION CORALLIOIDES N. Mt. Eielson, *W* 10228. This seems to be the first locality for the interior. It is reported from some few localities in E. and W. Pacific Coast, the Aleutians and Bering Sea.

JUNGERMANNIA SPHAEROCARPA Hook. Wonder L., on mud in pothole (Sherrard, 1957).

LEIOCOLEA GILLMANII (Aust.) Evans. Thoroughfare R. with *Scapania cuspiduligera*, *W* 10066A; with *Preissia quadrata*, *Tritomaria quinquedentata*, *Tayloria froelichiana*, *Blepharostoma trichophyllum* and *Encalypta alpina* *W* 10057A.

LEIOCOLEA HETEROCOLPA (Thed.) Buch. Wonder L., on clay bank in willow and alder grove, with *Fissidens adiantoides* (Sherrard, 1957).

LEIOCOLEA RUTHEANA (Limpr.) Evans [*L. schultzii* (N.) Jörg.]. Wonder L., on bank of pothole with *Dicranum groenlandicum* (Sherrard, 1957).

LOPHOCOLEA MINOR N. McKinley Bar, in middle of trail, on packed ground, *W* 10427. New to Alaska. Evans (1903) reports it from one locality in Yukon.

LOPHOZIA ALPESTRIS (Schleich.) Evans. Mt. Eielson, with *Gymnomitrion concinnatum*, *W* 10265 *p.p.*: Wonder L., on wet soil of a pothole (Sherrard, 1957).

LOPHOZIA EXCISA (Dicks.) Dum. McKinley, Park, *Lepage* 22102 (Persson, 1952).

LOPHOZIA INCISA (Schrad.) Dum. Thoroughfare R., *W* 10081; Mt. Eielson, with *Cephalozia pleniceps*, *W* 10253.

LOPHOZIA LONGIDENS (Lindb.) Macoun. Mt. Eielson, with *Cirriphyllum cirrosum*, *Tayloria lingulata*, *Isopterygium pulchellum*, *Encalypta alpina*, *W* 10046A. This is known in Alaska-Yukon from one locality in Centr. Yukon R. (Persson & Gjaerevoll, 1957) and one in Centr. Pacific Coast (Persson, 1949).

LOPHOZIA VENTRICOSA (Dicks.) Dum. Wonder L., on moist soil of upland tundra (Sherrard, 1957); ditto, with *Blepharostoma trichophyllum*, *W* 10325; Kahiltna Glacier, with *Dicranum fuscescens*, *V* 1064 *p.p.*

LOPHOZIA WENZELII (N.) St. Thoroughfare R., in drying tundra pool with *Cephaloziella divaricata*, *W* 10160. This seems not to have been published for Alaska save for Central Yukon R. (Gjaerevoll & Persson, 1957). Evans (1903) reported one locality from Yukon. I have named several specimens from Centr. Pacific Coast, as well as from the Aleutians.

MACRODIPLOPHYLLUM PLICATUM (Lindb.) H. Perss. Mt. Eielson, in crevices between boulders, with *Paraleucobryum enerve*, *Dicranum fuscescens*, *Diplophyllum taxifolium*, *Tritomaria quinquedentata* and *Sphenolobus minutus*, *W* 10244, 10288. This is the first inland locality for this species, the distribution of which I (1949) summarized as follows: "This large and beautiful Pacific endemic follows the coast from Washington to Alaska and is also found on the Asiatic side of the Pacific, as Sachalin, Ussuria, and Japan." In the same paper 21 new Alaskan localities were added to the

eight reported earlier, and the distribution of the three species of *Macrodiplophyllum*, all restricted to the northern coasts of the Pacific Ocean, were mapped.

MANNIA PILOSA (Hornem.) Frye & Clark. Thoroughfare R., with *Cephalozia pleniceps, Encalypta alpina, Pohlia cruda* and *Isopterygium pulchellum, W* 10039. Previously reported only from Centr. Yukon R. and Bering Strait.

MARCHANTIA POLYMORPHA L. Carlo, on silt, Nenana R. (Sherrard, 1957); McKinley Bar, *W* 10426; in shaded pocket beside small tundra stream surrounded by *Arctagrostis* stand, dry hills above Camp Eielson on north side of Thoroughfare R., 4000 ft., *W* 10414.

MARSUPELLA COMMUTATA (Limpr.) Bernet (*Sarcoscyphus commutatus* Limpr.; *S. densifolius* γ. *fasciculatis* Gottsche; *Marsupella parvitexta* Steph.). Thoroughfare R. on bare earth of a steep erosion slope near the upper edge of a bench on south side of the river near the mouth of Glacier Creek, *W* 10145. New to North America. DISTRIBUTION: Alps; Tatra; France (Massif Central); Schwarzwald. Japan.

Not previously recorded from Japan, this species was recently distributed as no. 432 in the ninth series of Hattori's *Hepaticae Japonicae* (on andesite rocks on ridge of Yatsu Mts., alt. ca. 2700 m., Nagano Pref., growing with *Anastrophyllum michauxii, Diplophyllum albicans* and *Bazzania tricrenata, D. Shimizu*, Aug. 11, 1952). Hattori (*in litt.*) says that it is rather common on high mountains in Japan.

Marsupella commutata is especially distinguished by the reflexed leaf margin and the chess-table configuration of the leaf cells (the trigones extremely large, resembling those in, *e.g., Odontoschisma macounii*). It is "a high-alpine species growing on primary rocks or their detritus (Müller, 1906-11). It is never found with either perianth or sporophyte but is obviously related to the species of sect. Funckiae of *Marsupella: M. funckii* (W. & M.) Dum., *M. pygmaea* (Limpr.) St., *M. badensis* Schiffn., *M. ramosa* K.M., and *M. alpina* (Gott.) Berenet (Müller, 1942). This group is represented in North America thus far only by *Marsupella alpina*, which some years ago was reported from Alaska (Persson, 1950).

MARSUPELLA EMARGINATA (Ehrh.) Dum. Carlo and Wonder L. (Sherrard, 1957).

MYLIA ANOMALA (Hook.) Gray. McKinley Bar, with *Dicranum bergeri* and *Polytrichum affine, W* 10344A. Previously reported only from E. Pacific Coast, Alaska Range and Yukon: Centr. Yukon R. I have also named specimens from Centr. and W. Pacific Coast, from Bering Sea, Bering Strait and Arctic Coast (Umiat, 1948, *Lepage* 22559).

NARDIA COMPRESSA (Hook.) Gray. Mt. Eielson, on rock outcrop, *V* 1186A, 1187A. This oceanic species had been reported in America only from Atka Island in the Aleutians (Evans, 1914) when in 1946a I published two localities in E. and one in Centr. Pacific Coast. From each of these districts I can add one locality: Kuiu I., Washington Bay, 1949, *Eyerdam* 185 and 200, and Evans I., 1948, *Eyerdam* 117 (on dripping rocks) and 162 (floating compact masses in mountaintop spring). As regards its ecology I cite Macvicar (1926): "On wet or submerged rocks in the subalpine and lower alpine regions ascending to 3500 ft. alts." (in Great Britain). Jörgensen (1934) in his splendid hepatic flora of Norway, unfortunately (because it is written in Norwegian) too little used, gives the ecology thus: "on wet places along brooks, sometimes also in bogs and on dripping rocks as well as on the bottom of brooks or rivers, always on siliceous ground"

(translated). Distribution: Western Europe, Alps, Tatra, Iceland, Greenland, Kamschatka, Alaska.

NARDIA SCALARIS (Schrad.) Gray. Wonder L., on soil with *Pogonatum capillare* (Sherrard, 1957). Regarding this somewhat oceanic species heretofore known from E. Centr. and W. Pacific Coast, the Aleutians and one locality in the interior (Centr. Yukon R.), see Gjaerevoll and Persson (1957).

ODONTOSCHISMA MACOUNI (Aust.) Underw. Thoroughfare R., with *Cynodontium alpestre, Cirriphyllum cirrosum, Plagiopus oederi* and *Isopterygium pulchellum, W* 10023 *p.p.* Previously recorded from the Bering Sea and a few localities in Centr. Yukon R. (Persson & Gjaerevoll, 1957).

ORTHOCAULIS KUNZEANUS (Hüb.) Buch. Mt. McKinley Park, *Lepage* 22102 (Persson, 1952a); Kahiltna Glacier, with *Dicranum fuscescens* and *Lophozia ventricosa, V* 1064 *p.p.*

ORTHOCAULIS QUADRILOBUS (Lindb.) Buch. Thoroughfare R., in *Sphagnum* bog, *W* 10117, 10173; McKinley Bar, with *Tomenthypnum nitens, W* 10358; Mt. Eielson, with *Ditrichum flexicaule, V* 1205 *p.p.*

PELLIA ENDIVIAEFOLIA (Dicks.) Dum. Kantishna, in shade on eroding bank of Eureka Creek, *W* 10385.

PELLIA NEESIANA (G.) Limpr. Mt. Eielson, with *Fissidens viridulus*, on overhanging edges of tundra terraces, *W* 10064 *p.p.*

PLECTOCOLEA RUBRA Evans. McKinley Bar, on bare ground in middle of trail on open tundra, *W* 10353. In 1942 this western endemic was reported by Clark and Frye from E. Pacific Coast as new to Alaska. It is a vicarious representative of *P. crenulata* (Sm.) Evans.

PLEUROCLADA ALBESCENS (Hook.) Spr. Wonder L., on wet soil in pothole (Sherrard, 1957).

PREISSIA QUADRATA (Scop.) N. Horseshoe L.; Kantishna, on sandy soil formed by flood water (Sherrard, 1957); ditto, *W* 10383; Thoroughfare R., *W* 10045.

PTILIDIUM CILIARE (L.) Hampe. Carlo (Sherrard, 1957); Thoroughfare R., *W* 10048; Kahiltna Glacier, on gravel bar under *Picea glauca, V* 1062B.

PTILIDIUM PULCHERRIMUM (Web.) Hampe. Garner, on thin soil over rock in aspen grove; Wonder L., on live *Picea glauca* (Sherrard, 1957).

RICCARDIA PINGUIS (L.) Gray. Horseshoe L., thin soil of rocky slope, with *Drepanocladus uncinatus*, etc. (Sherrard, 1957).

SACCOBASIS POLITA (N.) Buch. McKinley Bar, *W* 10346, 10347. Before reported from only one locality in Alaska: W. Pacific coast (Persson, 1947).

SCAPANIA CURTA (Mart.) Dum. Wonder L., on wet soil of pothole (Sherrard, 1957).

SCAPANIA CUSPIDULIGERA (N.) K. M. Thoroughfare R., with *Leiocolea gillmani, W* 10066; border of small tundra brook on ridge north of Camp Eielson, 4000 ft., *W* 10408. Only two localities are known in Alaska, both in Centr. Yukon R. (Persson, 1952a, Persson & Gjaerevoll, 1957).

SCAPANIA IRRIGUA (N.) Dum. Wonder L., *W* 10318 (also Sherrard, 1957).

SCAPANIA PALUDICOLA Loeske & K.M. Wonder L., on wet soil in depressions (Sherrard, 1957).

SPHENOLOBUS MINUTUS (Crantz) Steph. Wonder L. (Sherrard, 1957); Thoroughfare R., *W* 10082, 10142: McKinley Bar, *W* 10365. Close examination of tufts of *Dicranum elongatum* usually revealed this species to be present at least in small quantities.

SPHENOLOBUS SAXICOLA (Schrad.) Steph. Thoroughfare R., with *Cephaloziella arctica* and *Dicranum elongatum*, *W* 10072A.

TRITOMARIA QUINQUEDENTATA (Huds.) Buch. Thoroughfare R., *W* 10174, 10288 *p.p.*, 10057A *p.p.*, *V* 1205 *p.p.*, with *Ditrichum flexicaule*.

TRITOMARIA SCITULA (Tayl.) Jörg. Thoroughfare R., *W* 10203. New to Alaska. From Yukon only one locality is reported (Persson, 1946a). It is an arctic-alpine calciphile of continental type known from North America, Iceland, Jan Mayen and Europe.

SPHAGNALES

SPHAGNUM ANGUSTIFOLIUM C. Jens. [*S. parvifolium* Warnst. This species by several authors is included under *S. apiculatum* or *recurvum*.] East end of Wonder L., 13.8.1928, *Mexia* (*Luzula parviflora*); near center of north boundary of park, *Mexia* (Persson, *in litt.*).

SPHAGNUM APICULATUM H. Lindb. [*S. recurvum* P.B.] Wonder L., *Mexia* (*Andrews, in litt.*). This report may be founded on the same material as the foregoing.

SPHAGNUM BALTICUM Russ. McKinley Bar, growing intermixed with *S. lindbergii and S. magellanicum* in wet depressions between large tussocks in the backwaters of the river, *W* 10332 *p.p.*

SPHAGNUM COMPACTUM DC. Wonder L. (Harvill, 1947b); same locality, in small clumps on sides of tussocks, *W* 10323; Thoroughfare R., in tundra pool, *W* 10155.

SPHAGNUM FIMBRIATUM Wils. Wonder L., on sides of tussocks, *W* 10324; same locality, forming dense mat under *Picea mariana*, *V* 1770.

SPHAGNUM FUSCUM (Schp.) Klinggr. McKinley Park (Persson, 1952a); Wonder L. (Sherrard, 1957).

SPHAGNUM GIRGENSOHNII Russ. Wonder L. (Sherrard, 1957); Sanctuary-Teklanika Rivers (Harvill, 1947b); Mt. Eielson, *W* 10273; Lake Chelatna, *V* 1032.

SPHAGNUM LENENSE H. Lindb. Lake region, Kantishna, N. of Mt. McKinley (Persson, 1949); McKinley Bar, in hummocks with *Drosera rotundifolia*, mixed with *S. magellanicum*, *S. nemoreum*, *Mylia anomala* and *Drepanocladus badius*, *W* 10335. This interesting species is treated in detail by Persson (1949), where a map is given of its distribution in Alaska-Yukon and one of the closely related *S. lindbergii* Schimp. To the total distribution Greenland is to be added (Lange, 1952).

SPHAGNUM LINDBERGII Schp. Wonder L. (Sherrard, 1957); McKinley Bar, with *S. balticum* and *S. magellanicum* in wet places between tussocks, *W* 10332 *p.p.*

SPAGNUM MAGELLANICUM Brid. Wonder L. (Harvill, 1947b); McKinley Bar, with *S. lenense*, *W* 10335 *p.p.*; with *S. balticum* and *S. lindbergii*, *W* 10332 *p.p.*

SPAGNUM NEMOREUM Scop. [*S. capillaceum* (Weiss) Schrank; *S. acutifolium* auct. plur., non Ehrh.]. Wonder L. (Sherrard, 1957); Thoroughfare R., *W* 10212.

SPHAGNUM RIPARIUM Ängstr. Park Headquarters (Harvill, 1947b); Wonder L., forming elongate loose green strands in pools between large hummocks, *W* 10330.

SPHAGNUM RUBELLUM Wils. [*S. capillaceum* var. *tenellum* (Schimp.) Andrews]. Triple L. and Wonder L. (Sherrard, 1957); Wonder L., *W* 10314.

SPHAGNUM SQUARROSUM Pers. Wonder L. (Sherrard, 1957); alder-

covered ravine, 63° 46′ N., 149° 55′ W., 3300 ft. (Harvill, 1947); Thoroughfare R., *W* 10197.

SPHAGNUM SUBSECUNDUM N. McKinley Bar, *W* 10348, 10362, 10371. Before reported from Centr. Pacific Coast, the Aleutians, Centr. Yukon R. and Bering Strait (Williams, 1921; Persson, 1949).

SPHAGNUM TERES Ångstr. Thoroughfare R., *W* 10168; Wonder L., *W* 10315; Mt. Eielson, *V* 1267, 1342.

SPHAGNUM WARNSTORFIANUM DR. (*S. warnstorfii auct.*) Thoroughfare R., *W* 10167. In the literature this species is reported from E. and Centr. Pacific Coast, Centr. Yukon R. and Yukon: Upper Yukon R. I have also named specimens from W. Pacific Coast, Lower Yukon R., Bering Strait and Arctic Coast (Umiat, 1948, *Lepage* 22545).

MUSCI

ABIETINELLA ABIETINA (Hedw.) C.M. [*Thuidium abietinum* (Schw.) Br. & Sch.] Polychrome Pass; Savage R. (Persson & Gjaerevoll, 1957); Sanctuary R., Garner, Kantishna and Wonder L. (Harvill, 1947b; Sherrard, 1957); Wonder Lake, on a boulder by northwest shore, with *Massalongia carnosa* and *Dendriscocaulon dendroides*, *W* 10320.

ALOINA BREVIROSTRIS (Hook. & Grev.) Kindb. Carlo (Sherrard, 1957).

AMBLYSTEGIELIA SPRUCEI (Bruch) Loeske. Horseshoe L. (Sherrard, 1957); Kantishna, *W* 10380.

AMBLYSTEGIUM JURATZKANUM Schimp. Horseshoe L. (Sherrard, 1957).

AMBLYSTEGIUM SERPENS (Hedw.) BSG. Horseshoe L. and Kantishna (Sherrard, 1947).

ANDREAEA RUPESTRIS Hedw. (*A. petrophila* Ehrh.) Mt. Eielson, *W* 10080. One of the most ubiquitous mosses on boulders on mountain sides.

AONGSTROEMIA LONGIPES (Sommerf.) Br. & Sch. Kantishna (Sherrard, 1957); Kahiltna Glacier, on gravel bar with *Meesia uliginosa*, *V* 1059B.

APLODON WORMSKJOLDII (Hornem.) R.Br. (*Haplodon* of recent usage.) Lake Chelatna, on moose antler in bog, *V* 1068. Steere (1953) mapped the total distribution of this arctic species. Except for some localities on the northern slopes of the Brooks Range, there is no previous report from the interior of Alaska.

AULACOMNIUM ACUMINATUM (Lindb. & Arn.) Par. Triple L. (Sherrard, 1957). Kantishna, hillside above Red Top Mine, in deep moss mat over schist, ca. 2000 ft., 12.8.1957, *Shacklette* 4782.

AULACOMNIUM PALUSTRE (Hedw.) Schw. Sanctuary-Teklanika R. (Harvill, 1947); Thoroughfare R., *W* 10181; Wonder L. (Sherrard, 1957).

AULACOMNIUM TURGIDUM (Wg.) Schw. Sanctuary-Teklanika R. (Harvill, 1947); Wonder L. (Sherrard, 1957); Thoroughfare R., *W* 10078; Mt. Eielson, *V* 1170. Certainly one of the most common bryophytes in the park.

BARBULA CONVOLUTA Hedw. McKinley Park Station (Sherrard, 1957).

BARBULA ICMADOPHILA Br. & Sch. Thoroughfare R., in crevices of outcrop cliff behind prospect cabin, *W* 10049 (very depauperate); wet streamside, McKinley Bar, in fine fruiting condition, *W* 10361; on rock, "Mt. McKinley Park," *Lepage* 25588 (Persson, *in litt.*). Previously known from only two localities in Alaska-Yukon; Centr. Yukon R. and Bering Strait.

BARBULA sp. Kantishna, on decomposed chlorite schist at the summit of Quigley Hill, 3100 ft., 22.6.1957, *Shacklette* 4490. The material is poor and undeveloped. The species belongs, however, to the group centering around *B. vinealis* Brid., which in North America has a western distribu-

tion and consists of *B. cylindrica* (Tayl.) *Schimp.*, *B. brachyphylla* Sull. and *B. rubiginosa* Mitt., in addition to *B. vinealis*.

BARTRAMIA ITHYPHYLLA Brid. Triple Lake (Sherrard, 1957).

BLINDIA POLARIS (Berggr.) Hag. (*Seligeria polaris* Berggr.) Kantishna (Sherrard, 1957). Kantishna, on decomposed chlorite schist at summit of Quigley Hill, 3100 ft., 22.8.1957, *Shacklette* 4487.

BRACHYTHECIUM ALBICANS (Hedw.) Br. & Sch. Kantishna and Riley Creek (Sherrard, 1957); Mt. Eielson, locally abundant on seepy slope just below summit, 5500 ft., *W* 10219.

BRACHYTHECIUM GLAREOSUM (B.) BSG. Wonder L. (Sherrard, 1957).

BRACHYTHECIUM NELSONII Grout (*B. latifolium* Lindb.). Nenana R., Teklanika-Sanctuary R. (Harvill, 1947b); McKinley Park, 1928, *Mexia* (Persson, 1946a); Copper Mt. camp to Grant Cabin (on *Cardamine purpurea*), *Mexia* (Persson, *in litt.*); Thoroughfare R., *W* 10101, 10009A; Mt. Eielson, *W* 10295.

BRACHYTHECIUM REFLEXUM (Starke) BSG. Kantishna, alder thicket below Little Annie Mine, Quigley Hill, on soil with *Drepanocladus uncinatus*, ca. 2300 ft., 19.8.1957, *Shacklette* 4470, *c. fr.*

BRACHYTHECIUM SALEBROSUM (Web. & Mohr) BSG. Wonder L. (Sherrard, 1957).

BRACHYTHECIUM TURGIDUM (Hn.) Kindb. Savage R. (Persson, 1952b); Thoroughfare R., beside brook, under *Salix*, with *Drepanocladus revolvens* and *Campylium stellatum*, W 10133.

BRYOBRITTONIA PELLUCIDA Williams. Carlo, on silt, bank of Nenana R. (Sherrard, 1957).

BRYOERYTHROPHYLLUM RECURVIROSTRUM (Hedw.) Chen [*Barbula recurvirostris* (Hedw.) Dix.] Mt. Eielson, *W* 10306A.

BRYUM ARCHANGELICUM BSG. Kantishna and Triple L. (Sherrard, 1957). I have seen Sherrard's specimen. It is in poor condition, but it surely does not belong to *Bryum archangelicum*. It is highly doubtful that *B. archangelicum* is found in North America. This very good species has been misunderstood (Persson, 1952a, pp. 95-97). I have not yet seen an authentic American specimen of this species, which is rather common in the Scandinavian mountains, in the Alps, etc.

BRYUM ARCTICUM (R.Br.) BSG. Kantishna (Sherrard, 1957).

BRYUM ARGENTEUM Hedw. Polychrome Pass (Persson & Gjaerevoll, 1957); Carlo and Kantishna (Sherrard, 1957); Mt. Eielson, below eagle perch, *V* 1181; McKinley Bar, on overturned base of *Picea*, *W* 10369; rock crevices, dry tundra ridge north of Thoroughfare R. and Camp Eielson, 4000 ft., *W* 10401.

BRYUM CAESPITICIUM Hedw. Polychrome Pass, Savage R. (Harvill, 1947b); Wonder L. and Horseshoe L. (Sherrard, 1957).

BRYUM CALOPHYLLUM R.Br. Savage R. (Persson, 1952a).

BRYUM CIRRHATUM Hoppe & Hornsch. Thoroughfare R., in mud of gravel bar, *W* 10180; McKinley Bar, with *Oncophorus wahlenbergii*, *W* 10367.

BRYUM CUSPIDATUM Schp. [*B. affine* (B.) F. Schultz]. Kantishna, Riley Creek (Sherrard, 1957); Thoroughfare R., on gravel bar, *W* 10146.

BRYUM ELEGANS N. Muldrow Glacier, on a large boulder, mixed with *Abietinella*, *V* 1851. This was reported earlier from E. and W. Pacific Coast, the Aleutians and Central Yukon R. (Persson, 1952a; Gjaerevoll & Persson, 1957).

BRYUM INCLINATUM (Sw.) Sturm. Polychrome Pass (Sherrard, 1957);

Thoroughfare R., *W* 10092; Mt. Eielson, along stream in deep ravine, *V* 1258.

BRYUM PALLENS Sw. Kantishna; Wonder L. (Sherrard, 1957); Kahiltna Glacier, on gravel bar, *V* 1060.

BRYUM PALLESCENS Schleich. Kantishna and Wonder L. (Sherrard, 1957).

BRYUM PSEUDOTRIQUETRUM (Hedw.) Schwaegr. Wonder L. (Sherrard, 1957); Mt. Eielson, along stream in deep ravine, with *Distichium capillaceum, Ditrichum flexicaule, Bryoerythrophyllum recurvirostrum, V* 1204, *V* 1252, *V* 1264A; McKinley Bar, *W* 10349; zone of brush tundra along park highway between Miles 70 and 80, 2800 ft., 63° 26′ N., 150° 30-45′ W., *V* 1099.

BRYUM TURBINATUM (Hedw.) Schw. Carlo (Sherrard, 1957).

CALLIERGON GIGANTEUM (Schp.) Kindb. Garner and Lagoon (Sherrard, 1957).

CALLIERGON RICHARDSONII (Mitt.) Kindb. Wonder L., in small pool, with *Drepanocladus exannulatus, W* 10317.

CALLIERGON SARMENTOSUM (Wg.) Kindb. Carlo; Wonder L. (Sherrard, 1957); Thoroughfare R., in running brook, *W* 10165.

CALLIERGON STRAMINEUM (Brid.) Kindb. Alder-covered ravine, 63° 46′ N., 149° 55′ W., 2250 ft. (Harvill, 1947b); Wonder L. (Sherrard, 1957); Thoroughfare R., *W* 10177A.

CALLIERGON TURGESCENS (T. Jens.) Kindb. Thoroughfare R., forming soft julaceous masses in drying tundra pool on bench at base of Mt. Eielson, *W* 10151.

CAMPTOTHECIUM LUTESCENS (Hedw.) B. & S. Teklanika R. (Harvill, 1947b). This record seems doubtful.

CAMPYLIUM HALLERI (Hedw.) Lindb. Mt. Eielson, on rocks of outcrop behind prospect cabin, *W* 10053.

CAMPYLIUM POLYGAMUM (BSG.) Bryhn. Garner (Sherrard, 1957).

CAMPYLIUM STELLATUM (Hedw.) Lange & C. Jens. Wonder L. and Kantishna (Sherrard, 1957); Savage Camp, *Anderson;* center of north boundary, *Mexia* (Persson, *in litt.*); Mt. Eielson, beside a stream in a deep ravine, *V* 1255.

CATOSCOPIUM NIGRITUM (Hedw.) Brid. Polychrome Pass (Sherrard, 1957); West Fork Glacier, common on fine silt loams, *V* 1815; Kahiltna Glacier, gravel bar, *V* 1061.

CERATODON PURPUREUS (Hedw.) Brid. Kantishna, Triple L., Wonder L. (Sherrard, 1957); numerous records (Harvill, 1947b); Mt. Eielson, *W* 10254A, *V* 1172; Muldrow Glacier, *V* 1408; gravel bars of Thoroughfare R. and Glacier Creek, 3000 ft., *V* 1117.

CINCLIDIUM ARCTICUM (BSG.) Schp. Kantishna, in edge of pool, with *Catoscopium nigritum,* at the summit of Quigley Hill, 3000 ft., 16.8.1957, *Shacklette* 4440, *c.fr.*

CINCLIDIUM STYGIUM Sw. Wonder L., with *Drepanocladus revolvens, W* 10311; McKinley Bar, with *Meesia uliginosa, W* 10350 *p.p.;* Cathedral Mt. (Sherrard, 1957).

CINCLIDIUM SUBROTUNDUM Lindb. Mt. Eielson, in mat of *Calliergon stramineum,* in bog meadow, *V* 1339. This is the fifth locality in Alaska-Yukon. The first report was from the Arctic Coast (Williams, 1921). Later, one locality each in Bering Sea (St. Lawrence I.), Yukon (Persson, 1952b) and Arctic Coast (Steere, 1954b) were added.

CIRRIPHYLLUM CIRROSUM (Schw.) Grout. Inspiration Point (Persson,

1952, 1954); Sable Pass (Persson, 1952b); Thoroughfare R., in deep shaded crevices, *W* 10022; Mt. Eielson, on rock outcrop, *V* 1187; Kantishna (Sherrard, 1957).

CLIMACIUM DENDROIDES (Hedw.) Web. & Mohr. Kantishna (Sherrard, 1957); Mt. Eielson, around rocks and in depressions, *V* 1129; Thoroughfare R., beside brook, under *Salix*, W 10008, 10131.

CONOSTOMUM TETRAGONUM (Brid.) Lindb. (*C. boreale* Sw.) Polychrome Pass; Savage R., Dry Creek (Harvill, 1947; Sherrard, 1957); Mt. Eielson, *W* 10038, *V* 1343; Thoroughfare R., *W* 10179.

CRATONEURON FALCATUM (Brid.) Roth. Polychrome Pass (Sherrard, 1957); McKinley Bar, hillside bog, streamside, *W* 10337.

CRATONEURON FILICINUM (Hedw.) Roth. Horseshoe L. and Wonder L. (Sherrard, 1957).

CYNODONTIUM ALPESTRE (Wg.) Lindb. [*Cnestrum alpestre* (Wg.) Nyholm; *Cynodontium strumulosum* C.M. & Kindb. *in* Macoun.] Mt. Eielson, with *Odontoschisma macounii, Cirriphyllum cirrosum, Plagiopus oederi* and *Isopterygium pulchellum, W* 10023; Kantishna, on exposed quartz mica schist, Quigley Hill, 2500 ft., 19.9.1957, *Shacklette* 4453. Sherrard (1955) reported this species from two Alaskan localities (Centr. Yukon R.) as new to North America. Yet, the previous year Steere (1954b) in his work on chromosomes of arctic mosses (p. 101) stated that it "is not uncommon in Arctic Alaska and Canada."

I had at first referred Shacklette's specimen to *Cynodontium strumulosum* C.M. & Kindb. [the type of which is from "Hector, Rocky Mts., British Columbia. (Macoun)." This is all that is mentioned about its distribution in Grout's *Flora*]. A close comparison of *C. alpestre* and *C. strumulosum* has, however, convinced me that the latter is a synonymous with *alpestre*. The chief diagnostic characters are its acute, instead of obtuse leaves, and its oblique, subobovate and generally strumose, instead of symmetric and not strumose capsule. Almost all floras state that the leaves are obtuse in *alpestre* and the capsule erect and symmetric. But after studying a large series of European material I found that most leaves of *alpestre* are acute and that in most instances the capsule is asymmetric and not too rarely more or less strumose. In North American material of *strumulosum* the capsule characters are also quite variable. It is possible that the capsule is more often asymmetric in American material, but the differences are certainly too small to warrant maintaining *strumulosum* as a species.

Nyholm (1954) has transferred *C. alpestre* to the heretofore monotypic genus *Cnestrum* (Hagen, 1915). The reason for this is that *alpestre* has a stalked androecium, as does *Cnestrum schisti*, whereas the androecium of *Cynodontium* is sessile. To me it seems more important that *C. alpestre* has divided peristome teeth, but *Cnestrum* has undivided teeth. *C. alpestre* is not at all incongruous in *Cynodontium*, and Grout is correct when he states that *C. strumulosum* strongly resembles *C. gracilescens* (Web. & Mohr) Schimp.; yet concerning *C. alpestre*, which he places immediately after *strumulosum*, he only says: distinguished from *O. gracilescens* by the smaller size and rounded obtuse leaves." As to the size difference, Scandinavian specimens are not too rarely *taller* than specimens of *strumulosum* from North America.

Concerning *Cnestrum schisti*, which Grout places immediately after *alpestre* (and in the same genus, *Oncophorus*), he notes, after a full description, "In general appearance this species resembles *Rhabdoweisia* more than *Oncophorus*." I think the segregation of the genus *Cnestrum* itself may be

open to argument. It differs hardly more from other *Cynodontium* species than they do from each other. In any event, I am convinced that *C. alpestre* fits well in *Cynodontium*, where its relationship with *C. gracilescens* is obvious.

CYNODONTIUM POLYCARPUM (Hedw.) Schp. Mt. Eielson, on exposed ridge, 4000 ft., *V* 1168.

CYNODONTIUM STRUMIFERUM (Hedw.) DN. Carlo and Wonder L. (Sherrard, 1957).

CYNODONTIUM TENELLUM (BSG.) Limpr. Wonder L. (Sherrard, 1957).

CYRTOMNIUM HYMENOPHYLLUM (Br. & Sch.) Holmen (*Mnium hymenophyllum* Br. & Sch.) McKinley Park, 1928, *Mexia* (Persson, 1947); Mt. Eielson, below a snowbank, *V* 1203; ditto, along a stream in a deep ravine, *V* 1256; Thoroughfare R. with *Distichium capillaceum*, W 10004A.

DESMATODON LATIFOLIUS (Hedw.) Brid. Kantishna, with *Encalypta rhabdocarpa*, *W* 10379.

DICHELYMA UNCINATUM Mitt. In shallow water of pond margin, tundra, east side of Wonder L., south of the Ranger Station, 1900 ft., *W* 10393. New to Alaska-Yukon. TOTAL DISTRIBUTION (after Grout): "northern United States and southern Canada, especially in the western portions." This species, the type of which was collected by Lyall in British Columbia, is closely related to *D. falcatum* (Hedw.) Myr., a circumpolar, boreal species.

DICRANELLA CERVICULATA (Hedw.) Schp. Kantishna (Sherrard, 1957).

DICRANELLA CRISPA (Hedw.) Schp. Sushana R., Kantishna, Wonder L. (Harvill, 1947; Sherrard, 1957).

DICRANELLA HETEROMALLA (Hedw.) Schp. Wonder L. (Sherrard, 1957).

DICRANELLA SCHREBERI (Hedw.) Schp. Near center of north boundary of park, 700 m., 1928, *Mexia* (with *Carex* spp.) (Persson, *in litt.*). This has been reported only once (Persson, 1954) from Alaska-Yukon: two localities in E. Pacific Coast. Both belonged to var. *lentum* (Wils.) Möll.

DICRANELLA SQUARROSA (Starke) Schp. Kantishna, in edge of pool at the summit of Quigley Hill, 3000 ft., 16.8.1957, *Shacklette* 4441. This is the first inland locality for this beautiful suboceanic species which is reported from some few localities in W. Pacific Coast and the Aleutians.

DICRANELLA SUBULATA (Hedw.) Schp. Wonder L. (Sherrard, 1957).

DICRANELLA VARIA (Hedw.) Schp. Carlo and Wonder L. (Sherrard, 1957).

DICRANOWEISIA CRISPULA (Hedw.) Lindb. Probably one of the most characteristic mosses of tundra boulders as well as gravel bars, Mt. Eielson, *W* 10258, 10223, 10267, *V* 1259A, 1273; Thoroughfare R., *W* 10093, 10099, 10130; junction of Muldrow Glacier and the glacier from Anderson Pass, 4000-5000 ft., 63° 18′ N., 150° 18′ W., *V* 1406; Lake Chelatna, *V* 1022; Kahiltna Glacier, V 1067B.

DICRANUM ACUTIFOLIUM (Lindb. & Arn.) C. Jens. Garner and Kantishna (Sherrard, 1957).

DICRANUM BERGERI Bland. Horseshoe L., McKinley Bar, with *Mylia anomala* and *Polytrichum affine*, *W* 10344.

DICRANUM ELONGATUM Schleich. Garner and Sable Mt. (Sherrard, 1957; Harvill, 1947b); Mt. Eielson, *W* 10140, *V* 1146, 1146A: Thoroughfare R., *W* 10195, 10140; on old stump in thick *Picea glauca* stand near Teklanika Campground, *V* 1789. The most abundant *Dicranum* on the open tundra, almost always mixed with *Sphenolobus minutus*.

DICRANUM FRAGILIFOLIUM Lindb. Sanctuary R., 2100 ft. (Harvill, 1947b).

DICRANUM FUSCESCENS Turn. Kantishna, Carlo, Wonder L. (Sherrard, 1957); Mt. Eielson, *W* 10256, *V* 1363C; Kahiltna Glacier, on boulder of old moraine, under *Picea glauca*, *V* 1064; Sanctuary-Teklanika R. (Harvill, 1947b).

DICRANUM GROENLANDICUM Brid. Kantishna and Wonder L. (Sherrard, 1957); Wonder L., in a *Sphagnum* bog, *W* 10328.

DICRANUM MAJUS Turn. Igloo Creek camp (Harvill, 1947b); Thoroughfare R., *W* 10153; Muldrow Glacier, *V* 1292.

DICRANUM MUEHLENBECKII Br. & Sch. Kantishna and Wonder L. (Sherrard, 1957); McKinley Bar, *W* 10345; gravel bars of Thoroughfare R. and Glacier Creek, 3000 ft., 63° 24′ N., 150° 20′ W., under low *Betula* clumps, *V* 1439; Muldrow Glacier, *V* 1294.

DICRANUM SCOPARIUM Hedw. Carlo (Sherrard, 1957).

DISTICHIUM CAPILLACEUM (Hedw.) Br. & Sch. Horseshoe L. and Kantishna (Sherrard, 1957); Mt. Eielson, *V* 1173, 1174, 1266; Thoroughfare R., *W* 10004; zone of high brush tundra along park highway between Mile 70 and 80, 2800 ft., 63° 26′ N., 150° 30-45′ W., *V* 1103.

DISTICHIUM INCLINATUM (Hedw.) Br. & Sch. Kantishna, *W* 10375 (also Sherrard, 1957); McKinley Bar, with *Meesia uliginosa*, *Drepanocladus revolvens*, *W* 10350A.

DITRICHUM FLEXICAULE (Schleich.) Hampe. McKinley Park, *Mexia* (Persson, 1954); Kantishna (Sherrard, 1957); Mt. Eielson, with *Tritomaria quinquedentata* and *Orthocaulis quadrilobus*, *V* 1205; Thoroughfare R., in depression on gravel bar, with *Hypnum cupressiforme*, *W* 10027, 10148; gravel bars of Thoroughfare R. and Glacier Creek, 3000 ft., 63° 24′ N., 150°20′ W., invading in and around *Dryas* clumps, *V* 1431, 1433.

DITRICHUM HOMOMALLUM (Hedw.) Hampe. Lake Chelatna, in disturbed area, *V* 1030.

DREPANOCLADUS ADUNCUS (Hedw.) Warnst. Wonder L. (Sherrard, 1957); Sanctuary-Teklanika Rivers (Harvill, 1947).

DREPANOCLADUS BADIUS (H.) Roth. Horseshoe L. (Sherrard, 1957); Thoroughfare R., in tundra pool with *Sphagnum compactum*, *W* 10155 *p.p.*; McKinley Bar, with *Sphagnum lenense*, *W* 10335; Wonder L., 700 m., with *Tofieldia*, *Mexia* (Persson, *in litt.*).

DREPANOCLADUS CAPILLIFOLIUS (Warnst.) Warnst. Garner (Sherrard, 1957).

DREPANOCLADUS EXANNULATUS (Gümb.) Warnst. Thoroughfare R., with *Calliergon sarmentosum*, W 10186; Wonder L., with *Calliergon richardsonii*, *W* 10317 *p.p.*

DREPANOCLADUS FLUITANS (Hedw.) Warnst. Lagoon (Sherrard, 1957).

DREPANOCLADUS PSEUDOSARMENTOSUS (Card. & Thér.) H. Perss. McKinley Bar, with *Sphagnum subsecundum*, *W* 10362A. A very interesting find of a much discussed, critical species not found outside Alaska. Its distribution (including the above locality) is mapped and its taxonomy discussed by Gjaerevoll and Persson (1957).

DREPANOCLADUS REVOLVENS (Sw.) Warnst. Carlo and Wonder L. (Sherrard, 1957); 700 m., *Mexia* (Persson, *in litt.*); Thoroughfare R., *W* 10133A, 10162, 10196; McKinley Bay, *W* 10343, 10311 *p.p.*, with *Cinclidium stygium*.

DREPANOCLADUS TUNDRAE (Arn.) Loeske. Lagoon and Wonder L. (Sherrard, 1957); McKinley Bar, floating in pools with *Scorpidium scorpioides*, characteristically showing beautifully pinnate branching, differing markedly from the other aquatic species, *W* 10340, 10352.

DREPANOCLADUS UNCINATUS (Hedw.) Warnst. Numerous records (Harvill, 1947b); Savage R., *Mexia; Murie* (Persson, *in litt.*) McKinley Bar, *W* 10435; Thoroughfare R., *W* 10018, 10069, 10071; Kahiltna Glacier, *V* 1067C, 1059, 1059A.

DREPANOCLADUS VERNICOSUS (Lindb.) Warnst. Garner (Sherrard, 1957).

ENCALYPTA AFFINIS Hedw. *fil.* (*E. apophysata* Nees & Hornsch.) Kantishna, on thin soil over graphitic schist cliff at summit of Quigley Hill, 3000 ft., 16.8. 1957, *Shacklette* 4432. This splendid species has not been reported from Alaska-Yukon since 1892 when it was given for the first time (as *E. macounii* Aust.) for Kodiak Island in W. Pacific Coast and Unalaska I. in the Aleutians (Macoun, 1892). The distribution in North America is given in Grout as: "Rocky Mountains, Montana, and northwards."

ENCALYPTA ALPINA Sm. Thoroughfare R., with *Lophozia longidens, Cirriphyllum cirrosum, Tayloria lingulata* and *Isopterygium pulchellum, W* 10046; Mt. Eielson, *W* 10039, *p.p.* 10057 *p.p.* Grout gives its distribution in North America as "Alaska to Colorado, British Columbia, and Washington." However we have found no other locality in the literature except Steere's statement (1954a) that "in the Point Barrow area *E. alpina* is the most abundant species of the genus." Otherwise known only from two localities in Alaska-Yukon, both in Centr. Yukon R. (Persson, 1949; Sherrard, 1955).

ENCALYPTA RHABDOCARPA Schw. Kantishna, with *Myurella julacea, W* 10374.

ENTODON ORTHOCARPUS (LaPyl.) Lind. Mt. Eielson, around eagle perch, *V* 1179.

EURHYNCHIUM PULCHELLUM (Hedw.) Jenn. Horseshoe L. (Sherrard, 1957).

EURHYNCHIUM SUBSTRIGOSUM Kindb. Polychrome Pass (Harvill, 1947b).

FISSIDENS ADIANTOIDES Hedw. Wonder L. (Sherrard, 1957).

FISSIDENS OSMUNDIOIDES Hedw. Garner (Sherrard, 1957); McKinley Park, *Mexia* (Persson, 1954); McKinley Bar, along sides of wet depressions on forest edge, *W* 10364; with *Meesia uliginosa, W* 10350.

FISSIDENS VIRIDULUS Wg. Wonder L. (Sherrard, 1957); Mt. Eielson, on underhangs of tundra creep terraces, with *Pohlia cruda, Isopterygium pulchellum, Bryoerythrophyllum recurvirostrum, Pellia neesiana, Preissia quadrata, Tayloria lingulata* and *Mnium rugicum, W* 10006, 10064.

FUNARIA HYGROMETRICA Hedw. Carlo (Sherrard, 1957); zone of high brush tundra along the park highway between Mile 70 and 80, 2800 ft., 63° 26′ N., 150° 30-45′ W., *V* 1102 *p.p.*, with *Pohlia vexans.*

GOLLANIA DENSEPINNATA Dix. Kantishna, 63° 33′ N., 150° 56′ W., tor above saddle to Little Annie Mine, on schist rock; sun; upland tundra vegetation, 15 July 1951, *Sherrard* C16 (Sherrard, 1957; Ando *et al.*, 1957).

GRIMMIA OVALIS (Hedw.) Lindb. (*G. affinis* Hornsch.) Kantishna, Wonder L. (Sherrard, 1957); Polychrome Pass (Persson, 1952b); Thoroughfare R., frequent on boulders on talus slopes, *W* 10100A, 10100; Mt. Eielson, *V* 1185; Kahiltna Glacier, on gravel bar under *Piceae glauca, V* 1063 *p.p.*

GRIMMIA TENUICAULIS Williams, Kantishna (Sherrard, 1957).

HABRODON LEUCOTRICHUS (Mitt.) H. Perss. Kantishna, mountain side by Frank Bonnell's mine at junction of Eldorado and Reinhart Creeks, on alder trunk, ca. 2100 ft., 28.8.1957, *Shacklette* 4560; same, on surface of exposed granite boulder, *Shacklette* 4569. This interesting, diminutive spe-

cies had been reported only from the coast and no farther north than 60° 45′ (Persson, 1946, 1947; Harvill, 1950) when Sherrard (1955) reported it from Walker Lake in the northwest part of Centr. Yukon R. at 67° 10′. According to Steere (unpublished), it has a wide distribution on the arctic coast.

HELODIUM BLANDOWII (Web. & Mohr) Warnst. Thoroughfare R., in bog of river backwater, *W* 10176.

HYGROHYPNUM COCHLEARIFOLIUM (Vent.) Broth. Mt. Eielson, on rocks in stream, ravine behind prospect cabin, *W* 10301, *V* 1254. New to Alaska-Yukon. Grout gives one locality each in Washington and Montana. It is known elsewhere from Europe (Alps, Tatra, Pyrenees); Greenland.

HYGROPHYPNUM LURIDUM (Hedw.) Jenn. (*Hypnum palustre* L.) Garner, Lagoon and Wonder L. (Sherrard, 1957).

HYGROHYPNUM NORVEGICUM (Br. & Sch.) Grout. (*H. viridulum* Hn.). Riley Creek (Sherrard, 1957); Mt. Eielson, on boulders in the middle of a brook, narrow ravine on north side of mountain just behind prospect cabin, *W* 10305, *V* 1253, *V* 1262. This is the second locality in Alaska and North America for this interesting moss which was reported as new to North America by Sherrard in 1957.

HYGROHYPNUM OCHRACEUM (Turn.) Loeske. Camp Eielson, Kantishna, Lagoon (Sherrard, 1957).

HYLOCOMIUM PYRENAICUM (Spr.) Br. & Sch. Mt. Eielson, *W* 10009B; McKinley Bar, with *Barbilophozia lycopodioides* and *Rhytidiadelphus triquetrus*, *W* 10292 *p.p.*

HYLOCOMIUM SPLENDENS (*Hedw.*) Br. & Sch. Numerous records (Harvill, 1947b; Sherrard, 1957); Thoroughfare R., *W* 10127; Muldrow Glacier, *V* 1128, 1290, 1291A; gravel bars of Thoroughfare R. and Glacier Creek, *V* 1438.

HYPNUM BAMBERGERI Schp. McKinley Park, 1050 m., 1928, *Mexia* (Persson, 1954).

HYPNUM CALLICHROUM Brid. Wonder L. (Sherrard, 1957).

HYPNUM CUPRESSIFORME Hedw. Horseshoe L. and Kantishna (Sherrard, 1957); Thoroughfare R., with *Ditrichum flexicaule*, *W* 10027 *p.p.*

HYPNUM LINDBERGII Mitt. (H. *arcuatum* Lindb.) McKinley Park, 1100 m., 1928, *Mexia* (Persson, 1954); Wonder L. (Sherrard, 1957).

HYPNUM LINDBERGII var. ELATUM (Schp.) Ketchl. Wonder L. (Sherrard, 1957).

HYPNUM REVOLUTUM (Mitt.) Lindb. Savage R. (Persson & Gjaerevoll, 1957); Mt. Eielson, *W* 10224; Muldrow Glacier, around pothole, *V* 1296; dry tundra ridge above Camp Eielson, north of Thoroughfare R., *W* 10401A and B.

HYPNUM SUBPLICATILE (Lindb.) Limpr. Riley Creek and Wonder L. (Sherrard, 1957); Mt. Eielson, with *Diplophyllum taxifolium*, *W* 10289A *p.p.*

HYPNUM VAUCHERI var. COELOPHYLLUM Mol. Kantishna (Sherrard, 1957).

ISOPTERYGIUM MUELLERIANUM (Schimp.) Lindb. Mt. Eielson, with *Diplophyllum taxifolium* and *Hypnum subplicatile*, *W* 10289 *p.p.* This handsome moss was previously known from some localities in Centr. and W. Pacific Coast as well as the Aleutians (Persson, 1946; Harvill, 1950).

ISOPTERYGIUM PULCHELLUM (Hedw.) Broth. Triple L. (Sherrard, 1957); Mt. Eielson, with *Distichium capillaceum*, *W* 10004 *p.p.*; with *Encalypta*

alpina, W 10046 *p.p.*; with *Preissia quadrata*, *Pohlia cruda*, *W* 10004A; also mixed with other species, *W* 10023 *p.p.*, 10039 *p.p.*, 10170 *p.p.*

KIAERIA FALCATA (Hedw.) Hag. [*Dicranum falcatum* Hedw.; *Arctoa falcata* (Hedw.) Grout]. Kahiltna Glacier, in mat of *Andreaea rupestris*, under *Picea glauca* on gravel bar, *V* 1063C. Grout lists this species for "Washington and Oregon, northwards to Alaska." It was reported from Lake Lindeman in Yukon, Upper Yukon R., by Williams (1921), and we have seen an unpublished specimen from Centr. Pacific Coast: Thum Bay, 1939, *Eyerdam* 596. This is an alpine-oceanic moss otherwise distributed in Europe (especially the western parts), Iceland, the Faeroes and Jan Mayen.

KIAERIA GLACIALIS (Berggr.) Hag. [*Dicranum arcticum* Schp.; *D. glaciale* Berggr.]. Kantishna and Wonder L. (Sherrard, 1957).

LEPTOBRYUM PYRIFORME (Hedw.) Schimp. Carlo, Kantishna, Horseshoe L.; Triple L. and Wonder L. (Sherrard, 1957); zone of high brush tundra along park highway between Miles 70 and 80, 2800 ft., 63° 26′ N., 150° 30-45′ W., *V* 1102 *p.p.*, with *Pohlia vexans*.

LESCURAEA SAXICOLA (BSG) Milde [*L. frigida* Kindb.; *Pseudoleskea substriata* Best, *P. frigida* (Kindb.) Sharp]. Thoroughfare R., mossy tundra above south bank, *W* 10096. New to Alaska. This alpine species is, according to Lawton (1957), heretofore known from British Columbia, Quebec, Laborador, Vermont and one station in Utah, as well as from various parts of Europe. *Pseudoleskea frigida* is reported from one locality in the Aleutians (Harvill, 1947), but Lawton has included this specimen under her new species *Lescuraea iliamniana*, which is known from one locality in Alaska and one in British Columbia (the latter *sub P. frigida* by Williams). *L. iliamniana* is closely related to *L. saxicola* and yet more with the Japanese *L. julacea* Besch. & Card. According to Lawton, "no distinguishing characters have been found" for the gametophytes, but "the structure of the outer peristome is quite different."

LESCURAEA STENOPHYLLA (Ren. & Card.) Kindb. [*Pseudoleskea rigescens* Best]. Thoroughfare R., *W* 10005. The specimen was, after Grout's *Flora*, named *Pseudoleskea rigescens*, which according to Lawton (1957) is a synonym of *L. stenophylla*. This is an endemic of the West ranging from Alaska to Idaho and Montana.

LESKEELLA NERVOSA (Brid.) Loeske [*Leskea nervosa* (Brid.) Myr.] Kantishna (Sherrard, 1957).

LESKEELLA TECTORUM (A.Br.) Hag. Mt. Eielson, *W* 10013. In 1957 this species was reported as new for Alaska by Persson and Gjaerevoll from Centr. Yukon R. It is also known from Yukon.

MEESIA TRIQUETRA (Hook. & Tayl.) Ängstr. Wonder L. (Sherrard, 1957); McKinley Bar, forming a huge moss mound ca. 1 meter high with *Drepanocladus revolvens* beside stream on margin of forest, *W* 10355.

MEESIA ULIGINOSA Hedw. Polychrome Pass, approaching var. *minor* (Brid.) BSG (Sherrard, 1957); McKinley Bar, in wet depressions on forest edge, with *Fissidens osmundioides*, *W* 10350; Thoroughfare R., with *Isopterygium pulchellum*, *Blepharostoma trichophyllum*, W 10170; Park Headquarters (Harvill, 1947b).

MNIUM CUSPIDATUM Hedw. Carlo (Sherrard, 1957).

MNIUM MEDIUM Br. & Sch. Kantishna, with *Pohlia cruda* and *Drepanocladus uncinatus*, *W* 10382.

MNIUM ORTHORRHYNCHUM Br. & Sch. Sable Pass (Harvill, 1947b); Horseshoe L. and Kantishna (Sherrard, 1957); Thoroughfare R., with *Bryum pseudotriquetrum*, *W* 10002; junction of the Muldrow Glacier and

the glacier from Anderson Pass, 4500 ft., 63° 18′ N., 150° 18′ W., *V* 1372, around roots of *Cystopteris fragilis* on steep rocky ridge.

MNIUM PSEUDOPUNCTATUM Br. & Sch. Wonder L. (Sherrard, 1957); Mt. Eielson, *W* 10296A; Lake Chelatna, *V* 1039.

MNIUM PUNCTATUM var. ELATUM Schimp. Wonder L. (Sherrard, 1957); Mt. Eielson, *W* 10296; McKinley Park (Harvill, 1947b). Mårtensson (1956) states: "The robust, luxuriant var. *elatum* Schimp. is a curious plant. It is generally referred to *M. punctatum* but shares many features (such as the tomentose stems) with *M. pseudopunctatum*. It is difficult to say, from purely morphological and floristical points of view, what this type really is." I pointed out in 1947 that it is possible that var. *elatum* is a mixture of different things, perhaps partly of hybrid nature. (It seems to be especially common in regions where *M. pseudopunctatum* and *M. punctatum* grow together. This should, together with the often tall stature, the pronounced sterility and the somewhat intermediate characters of the leaf, speak in favor of a hybrid origin.)

Cardot and Thériot (1902) reported var. *elatum* from several localities along the coast of Alaska up to St. George I. in Bering Sea. I have also seen it from several localities in the same area. But in this region, as well as in western North America on the whole, true *M. punctatum* is not represented. Since var. *elatum* furthermore seems to look the same in the West as in other parts of its range, *e.g.*, Europe, it is possible that the hybrid-origin hypothesis must be discarded. Experimental crossings between *M. punctatum* and *M. pseudopunctatum* would be of considerable interest. Until the biology of the group is better understood it might be best to treat var. *elatum* as a proper species.

In this connection it may be worthwhile to say a little about the *M. punctatum-pseudopunctatum* group in North America. Andrews in Grout's *Flora* places *M. pseudopunctatum*, among others, in synonymy under *M. punctatum*. In my paper of 1947 I discussed the relationship between these two species and pointed out that *M. pseudopunctatum* is a first-class species. This is the common opinion among bryologists. Since this was written, *M. pseudopunctatum* has proved to be in itself a collective species. It is being studied closely by Steere, who will publish on his interesting investigation of what might be called the undergroup *M. pseudopunctatum sens. lat.* Here I only note that *M. pseudopunctatum* has a wide distribution in Alaska-Yukon, where it is, as in other parts of the Northern Hemisphere, confined to subalpine and alpine regions.

The other undergroup, *M. punctatum sens. lat.* is represented in North America, in addition to *M. elatum*, by three good species: *M. punctatum* (only east of the Rockies), *M. glabrescens* (only west of the Rockies where it is confined to the coast) and *M. nudum*, the distribution of which is not studied well enough but which also seems to be a western species confined mostly to the mountains. The latter may be classed as a subalpine-alpine species. All of these differ from *M. pseudopunctatum, inter alia,* in having larger capsules and a yellow (not brown) peristome.

Mnium glabrescens (*fide* Andrews, a synonym of *M. punctatum*) has been discussed in my 1947 paper wherein my conclusion was that it is a distinct species recognizable even at a glance by its leaf form (rather narrowly ovate) so different from that of *M. punctatum*. Good distinguishing characters are also found in other parts of the plant. *M. glabrescens* is one of the most common mosses along the coast of Alaska as well as British Columbia, often growing on logs but also on the ground.

Mnium nudum (also, *fide* Andrews, a synonym of *punctatum*) is a much-neglected species; it was recognized independently by Holzinger, who collected it in 1898, and Williams, who collected it in 1897. It was described by Britton and Williams (1900), who said that it "differs from *M. subglobosum* [*M. pseudopunctatum*] . . . in its dioicous inflorescence, naked stems and shorter pedicels, larger peristome with more numerous lamellae; from *M. punctatum* in the not thickened border of the leaves and the naked stems, not radiculose; and from *M. glabrescens* also in the not thickened border of the leaf, and stouter, more erect pedicel." It is important to add that from *glabrescens* it is distinguished also by the quite different leaf form which is about the same as in *punctatum* and *pseudopunctatum*.

Two years later Cardot and Thériot reported *M. nudum* from Yakutat Bay in E. Pacific Coast of Alaska as a species but stated that "it seems to us preferable to regard *M. nudum* as a subspecies of *M. punctatum*." They reported *M. glabrescens*, which they regarded without hesitation as a species, from many localities, "*Mnium punctatum elatum*" from several and *M. subglobosum* (*M. pseudopunctatum*) from a few stations.

In collections from Alaska I had met with specimens even long ago which I supposed to belong to *M. nudum*, but because the specimens were only fragmentary ones picked up from vascular plant sheets, I was uncertain about them. In the summer of 1957 I collected *M. nudum* in quantity in the Queen Charlotte Islands. It grew abundantly on the ground, richly fruiting, in an alpine forest of *Picea sitchensis*, *Thuja plicata*, and *Tsuga mertensiana* just below the tree limit, and at once I realized that I was seeing a very distinct and good species. On logs, close to *M. nudum*, occurred *M. glabrescens;* the two species were absolutely unlike one another.

MNIUM RUGICUM Laur. Kantishna (Sherrard, 1957); Thoroughfare R., *W* 10182.

MNIUM cf. SPINOSUM (Voit.) Schw. Kantishna, summit of Quigley Hill, on decomposed chlorite schist, 3100 ft., 22.8.1957, *Shacklette* 4485. Unfortunately the specimen is not in the best condition, and it is sterile. The only other species to be considered is the closely related *M. spinulosum* BSG, which is synoicous, whereas *M. spinosum* is dioicous. In this material the leaf cells are arranged in distinctly radiating lines, and the nerve is dorsally toothed; both these characters are typical of *spinosum* but not of *spinulosum*. The leaf cells are larger than in typical *spinulosum*, and the habit approaches that of *spinosum*. Nevertheless, it is probably best to consider this record doubtful until better material is available.

Andrews in Grout's *Flora* stated that *spinulosum* has a wide distribution in North America, whereas *spinosum* has not yet been found there. *M. spinulosum* has a much wider distribution in North America than in Europe, where it is found sparingly, sometimes growing in company with *M. spinosum*, from the Pyrenees through the Alps and eastward. In Europe it is replaced for the most part by *M. spinosum*, which is also widely distributed in northern Europe where *M. spinulosum* does not occur. Both species are reported from Caucasia, but *M. spinulosum* is not found in Asia. *M. spinosum*, on the other hand, is reported from central Asia: Tianschan (Herzog, 1926) and, as *M. rubricaule* Dix. & Sak., from northern China (Kabiersch, 1937). *M. spinosum* has a near relative in the southern parts of the Rocky Mountains, *M. arizonicum* Amann, but the Mt. McKinley specimen is quite different from this.

In Alaska *M. spinulosum* is reported from some few localities in E. and

Centr. Pacific Coast and in Yukon from one locality in Upper Yukon R. (Persson, 1947).

MYURELLA APICULATA (Hüb.) Br. and Sch. [*M. tenerrima* (Brid.) Lindb.] Kantishna, *W* 10389A, on steep bank of Eureka Creek, under *Alnus*.

MYURELLA JULACEA (Hedw.) Br. & Sch. Horseshoe L. (Sherrard, 1957); Kantishna, *W* 10389.

OLIGOTRICHUM ALIGERUM Mitt. Lake Chelatna, disturbed area, *V* 1035. This is a beautiful endemic of the Pacific Coast of North America and Japan, following the coast from Alaska down to Oregon. In Alaska it was known before only from E. and Centr. Pacific Coast.

OLIGOTRICHUM HERCYNICUM (Hedw.) Lam. & DC. Wonder L. (Sherrard, 1957).

OLIGOTRICHUM CAVIFOLIUM Wils. Kantishna (Sherrard, 1957).

ONCOPHORUS WAHLENBERGII Brid. Sanctuary R. (Harvill, 1947b); Thoroughfare R., *W* 10193; Kahiltna Glacier, common on gravel bar, *V* 1057, 1058; McKinley Bar, with *Bryum cirrhatum*, *W* 10367 *p.p.*

ONCOPHORUS VIRENS (Hedw.) Brid. Garner and Wonder L. (Sherrard, 1957); Thoroughfare R., in *Sphagnum-Paludella* bog, with *Meesia uliginosa*, *Drepanocladus revolvens*, *W* 10164.

ORTHOTRICHUM CONSIMILE Mitt. McKinley Bar, on bark of *Populus balsamifera*, with *O. speciosum* and *Stroemia obtusifolia*, *W* 10444 *p.p.* This is an endemic of the Pacific coast of North America from Alaska to California, following the coast. It seems to have been collected in Alaska only in E. Pacific Coast. It is closely related to *O. pulchellum* Brunt., which in North America is known only from Alaska and British Columbia; (in Europe it has a decidedly oceanic type of distribution).

ORTHOTRICHUM SPECIOSUM N. Wonder L., on *Populus balsamifera*, summit of ridge just west of the lake, *W* 10422; McKinley Bar, on *Picea* twigs, *W* 10428. Except for four localities in E. and W. Pacific Coast there is only one report from Alaska-Yukon, namely Centr. Yukon R.: Bettles, where the species was collected by L. H. Jordal in 1949 (Sherrard, 1955) and by H. Crum in 1953 (Steere, 1954b). One unpublished locality may be added: W. Pacific Coast: Karluk L., Camp II, on bark of cottonwood, 1935, *O. D. Clark*.

It is worthwhile to study the distribution of *O. speciosum*. Grout gives for *O. speciosum s. str.*: "California to British Columbia and Alaska. Forms agreeing with the European are more common in the Rocky Mts. and westward." As subspecies he has *O. elegans* Hook. & Grev.: "northern U. S. and southern Canada, mostly east of the Mississippi . . . This eastern form is distinctly different from the Western form which the author collected several times in the Colorado mountains." If we now study the distribution of *O. speciosum s. latiss.* outside North America, we find that *O. speciosum s. str.* has a wide distribution in Europe but avoids the oceanic parts; it is, for example, very rare in Great Britain, and in Sweden it is common in the east but very rare in the west. In Finland, Russia and Siberia we meet with *O. elegans*.

To *O. speciosum s. latiss.* belongs *O. killiasii C.M.*, which is an alpine-arctic species. It has a wide distribution in arctic North America (Steere, 1954a, where it is also, without locality, given for arctic Alaska). In Europe it is found in the Alps as well as in the Scandinavian mountain range and it is also known from Greenland and Altai.

PALUDELLA SQUARROSA (Hedw.) Brid. Triple L. and Wonder L. (Sherrard, 1957); Teklanika R. (Harvill, 1947); Thoroughfare R., in bog

formed by backwater of stream, with *Oncophorus virens*, *W* 10177; McKinley Bar, with *Tomenthypnum nitens*, *W* 10341 *p.p.*; Mt. Eielson, *V* 1340.

PARALEUCOBRYUM ENERVE (Thed.) Loeske. Mt. Eielson, in crevices of fell-field, with *Diplophyllum taxifolium*, *Macrodiplophyllum plicatum*, *W* 10288A.

PHILONOTIS TOMENTELLA Mol. Kantishna and Wonder L. (Sherrard, 1957); Copper Mountain (Mt. Eielson), *Mexia* (Persson, *in litt.*); Thoroughfare R., with *Timmia austriaca*, *Brachythecium nelsoni*, beside brook under *Salix*, *W* 10132; Mt. Eielson, along stream in deep ravine, *V* 1260, 1264.

PLAGIOBRYUM DEMISSUM (Hoppe & Hornsch.) Lindb. Kantishna, on run-off bed of Eureka Creek, *W* 10381; Kantishna, on bare humus soil on slope of Quigley Hill, ca. 2500 ft., 16.8.1957, *Shacklette* 4815. Grout stated that in America this species ranges from Greenland and the arctic regions southward in the Rockies to Colorado. Steere has told us that he has collected it in several places in arctic Alaska. This is a high alpine-arctic species of circumpolar distribution.

PLAGIOTHECIUM LAETUM Br. & Sch. Kantishna, *W* 10388.

PLAGIOTHECIUM PILIFERUM (Sw.) Br. & Sch. Sable Pass (Harvill, 1947).

PLAGIOTHECIUM ROESEANUM Br. & Sch. Kantishna, *W* 10386.

PLEUROZIUM SCHREBERI (Willd.) Mitt. Carlo, Kantishna, Triple L. and Wonder L. (Sherrard, 1957); Igloo Creek (Harvill, 1947); Thoroughfare R., *W* 10009, 10141; Muldrow Glacier, under *Salix* clump on gravel bar, *V* 1783A; Lake Chelatna, *Picea-Salix* stand, *V* 1031.

POGONATUM ALPINUM Hedw. Kantishna (Sherrard, 1957); Sanctuary R. (Harvill, 1947); Mt. Eielson, abundant in a late snow basin, replaced in dried spots by great masses of *Gymnomitrion concinnatum*, *W* 10228, 10257; Kantishna, *W* 10390.

POGONATUM CAPILLARE (Mx.) Brid. Mt. Eielson, *W* 10290; Wonder L., *W* 10329 (also Sherrard, 1957); Lake Chelatna, disturbed area, *V* 1069; McKinley Park, 1947, *Lepage* 22100, *c.fr.* (Persson, *in litt.*).

POGONATUM URNIGERUM (Hedw.) P-B. Wonder L. (Sherrard, 1957).

POHLIA ALBICANS (Wg.) Lindb. [*P. wahlenbergii* (Web. & Mohr) Andrews]. Kantishna (Sherrard, 1957); Mt. Eielson, *W* 10297. Here the species occurs in a pure stand on a spring bog and is visible for several miles because of its pale green color which contrasts strikingly with the surrounding tundra vegetation.

POHLIA ANNOTINA (Hedw.) Loeske. Wonder L. (Sherrard, 1957). Sushana R. (Harvill, 1947).

POHLIA COLUMBICA (Kindb.) Andrews. Kantishna, *c.fr.* (Sherrard, 1957).

POHLIA CRUDA (Hedw.) Lindb. Kantishna and Triple L. (Sherrard, 1957); Wonder L., *W* 10319; Mt. Eielson, *W* 10004A *p.p.*, 10039 *p.p.*, 10064 *p.p.*, with *Pellia*; Kantishna, *W* 10382 *p.p.*, with *Mnium medium*; without locality (Harvill, 1947).

POHLIA CRUDOIDES (Sull. & Lesq.) Broth. (*P. crassidens* Lindb.) Mt. McKinley National Park, Stoney Creek, slope by Bergh Lake, in crevices of intrusive basalt porphyry boulder in stream, ca. 3500 ft., 24.8.1957, *Shacklette* 4524. The type of *Bryum crudoides* was collected by C. Wright on the U. S. North Pacific Exploring Expedition, 1853-56, and bears only the locality, "Behring Strait"—whether on the American or Asiatic side is not clear. Andrews in Grout's *Flora* had nothing to say about its dis-

tribution in North America. In the Kindberg herbarium (Stockholm) I find a specimen from Yukon, Centr. Yukon R.: The Dome, collected by J. Macoun in 1902 and correctly named by Kindberg *Pohlia crassidens* (Persson, 1946a). In 1953 a second North American locality was added when O. Gjaerevoll collected *P. crudoides* in Centr. Yukon R. of Alaska (Persson & Gjaerevoll, 1957).

POHLIA DRUMMONDII (C.M.) Andrews. [*P. commutata* (Schp.) Lindb.]. Kantishna and Polychrome Pass (Sherrard, 1957); Mt. Eielson, *V* 1264 *p.p.*

POHLIA NUTANS (Hedw.) Lindb. Garner, Kantishna, Triple L. and Wonder L. (Sherrard, 1957); Park Headquarters; Sable Pass (Harvill, 1947b); Thoroughfare R., *W* 10193A; Lake Chelatna, disturbed area, *V* 1028.

POHLIA PROLIGERA Lindb. Kantishna (Sherrard, 1957).

POHLIA VEXANS (Limpr.) H. Lindb. Zone of high brush tundra along park highway between Mile 70 and 80, 2800 ft., 63° 26′ N., 150° 30-45′ W., with *Bryum inclinatum, Leptobryum pyriforme* and *Funaria hygrometrica*, *V* 1102. New to Alaska-Yukon. Andrews in Grout's *Flora* reports it from Idaho, Montana, British Columbia and Saskatchewan. Otherwise it is known from the Alps and from the Scandinavian mountains.

POLYTRICHUM AFFINE Funck [*P. strictum* Sm.] Mt. Eielson, *W* 10202, *V* 1338; Thoroughfare R., *W* 10152; Muldrow Glacier, *V* 1291; Wonder L., *W* 10326.

POLYTRICHUM COMMUNE Hedw. Kantishna and Wonder L. (Sherrard, 1957); Park Headquarters; Sable Pass (Harvill, 1947b); McKinley Bar, *W* 10354; Lake Chelatna, *V* 1029.

POLYTRICHUM FORMOSUM Hedw. McKinley Bar, in an open *Calamagrostis* bog on tundra, *W* 10333.

POLYTRICHUM HYPERBOREUM R.Br. Mt. Eielson, *W* 10271.

POLYTRICHUM JENSENI Moenk. Lower Savage R. (Harvill, 1947, *sub P. commune* var. *jenseni*).

POLYTRICHUM JUNIPERINUM Hedw. Carlo, Kantishna, Triple L. and Wonder L. (Sherrard, 1957); McKinley Park, 3000 ft.; Sanctuary-Teklanika Rivers (Harvill, 1947b).

POLYTRICHUM PILIFERUM Hedw. Garner, Kantishna and Wonder L. (Sherrard, 1957); Savage R., *Mexia* (Persson, *in litt.*); Mt. Eielson, *W* 10245; Kahiltna Glacier, on gravel bar, *V* 1066.

PTILIUM CRISTA-CASTRENSIS (Hedw.) DeNot. [*Hypnum crista-castrensis* Hedw.] Carlo, Kantishna and Wonder L. (Sherrard, 1957); Wonder L., *W* 10313.

PYLAISIA POLYANTHA (Hedw.) Br. & Sch. Kantishna, *W* 10384 (also Sherrard, 1957).

RHABDOWEISSIA cf. DENTICULATA (Brid.) BSG. Kantishna, mountain side by Frank Bonnell's mine, at junction of Eldorado and Reinhart Creeks, on soil and lichen mat over rotted alder roots, on cliff face, ca. 2100 ft., 28.8.1957, *Shacklette* 4562. There are extremely few collections of *Rhabdoweissia* from western North America. From Alaska Yukon Cardot and Thériot (1902) reported *R. fugax* from Kodiak (W. Pacific Coast) and *R. fugax* var. *subdenticulata* Boul. from Juneau (E. Pacific Coast). Grout in his *Flora* followed Williams when he stated that in North America north of Mexico only one *Rhabdoweissia* is represented, namely *R. denticulata*. But at the same time he stated that most American specimens differ from the European *denticulata* in the leaf form and the more or less pronounced lack of serration in the leaves, in both respects approaching *R. fugax*. Grout also

described *R. denticulata* var. *americana* Culm. *ex* Grout, characterized by having "leaves narrowly acute and sometimes almost entire. With the range of the species east of the Mississippi."

Shacklette's specimen, while well developed, unfortunately has old capsules with the peristomes almost totally destroyed. As the peristome presents the most deciding character distinguishing *R. denticulata* and *fugax* and also *R. kusenevae* Broth., a species of Amur and Japan very close to *denticulata,* it is not possible to name the Mt. McKinley specimen with certainty.

Outside North America *R. denticulata* occurs in the oceanic parts of Europe, whereas *fugax* has not only a wider distribution in Europe but is also known from Madeira, the Azores and Japan. Furthermore, Brotherus (in *Die natürlichen Pflanzenfamilien*) stated that *R. vulcanica* (C. M.) Mitt. from Mexico and *R. lindigiana* (Hampe) Mitt. from Colombia are identical with *R. fugax*. It may be added that Herzog (1916) reported *R. fugax* from several localities in the Bolivian Andes. I have studied a specimen of Herzog's material from Bolivia: Estradillas, an Erdbrücken, ca. 3400 m., June 1911, *Herzog* 3341. No doubt this specimen is closely related to *R. fugax*, especially with regard to the peristome, but the more abruptly acuminate leaves and the larger capsule suggest that it must be regarded as a proper species or subspecies.

RHACOMITRIUM CANESCENS var. ERICOIDES (Brid.) Br. & Sch. Kantishma, Cathedral Mt. and Wonder L. (Sherrard, 1957); Muldrow Glacier and Savage R. (Harvill, 1947); Mt. Eielson, *W* 10255, *V* 1130A: Thoroughfare R., *W* 10098, 10104, 10163, *V* 1440; Muldrow Glacier, *V* 1295; Kahiltna Glacier, *V* 1067. Very abundant in the Park, especially on gravel bars.

RHACOMITRIUM LANUGINOSUM (Hedw.) Brid. Cathedral Mt., Kantishna and Wonder L. (Sherrard, 1957); Mt. Eielson, *W* 10235, 10243, 10285, *V* 1272; Thoroughfare R., *W* 10012; many records (Harvill, 1947b; Persson, 1954).

RHYTIDIADELPHUS TRIQUETRUS (Hedw.) Warnst. Garner (Sherrard, 1957); Mt. Eielson, *W* 10292, *V* 1227; Muldrow Glacier, *V* 1783.

RHYTIDIUM RUGOSUM (Hedw.) Kindb. Garner, Kantishna and Wonder L. (Sherrard, 1957); Thoroughfare R., *W* 10010, 10077, *V* 1434; Muldrow Glacier, *V* 1298, 1781; several records (Harvill, 1947b); Savage R., *Murie, Mexia* (Persson, *in litt.*).

SAELANIA GLAUCESCENS (Hedw.) Lindb. Mt. Eielson, *W* 10293; McKinley Bar, *W* 10366.

SCHISTIDIUM ALPICOLA var. LATIFOLIUM (Zett.) Limpr. Mt. Eielson, on rocks splashed by a small stream, *V* 1250.

SCHISTIDIUM APOCARPUM (Hedw.) BSG. Kantishna (Sherrard, 1957, *sub* var. *gracile*); Mt. Eielson, *W* 10260, *V* 1186; Thoroughfare R., W 10019, 10076; Muldrow Glacier, *V* 1293.

SCORPIDIUM SCORPIOIDES (Hedw) BSG. Lagoon (Sherrard, 1957); Wonder L., *W* 10316; McKinley Bar, *W* 10340A, in pools with *Drepanocladus tundrae*.

SPLACHNUM LUTEUM Hedw. Polychrome Pass (Sherrard, 1957); dense *Picea glauca* stand adjacent to the Teklanika campground, *V* 1788A; Park Headquarters (Harvill, 1947b).

SPLACHNUM OVATUM Hedw. Thoroughfare R., *W* 10147; in dense *Picea glauca* stand adjacent the Teklanika campground, with *S. luteum*, V 1788.

SPLACHNUM RUBRUM Hedw. Lake Chelatna, in bog with *Tetraplodon*

mnioides, *V* 1027. In 1957 this was reported as new to Alaska-Yukon by Persson and Gjaerevoll.

STEGONIA LATIFOLIA (Schwaegr.) Vent. Dry tundra ridge north of Thoroughfare R. and above Camp Eielson, 4000 ft., *W* 10413. The first record of this species from Alaska-Yukon was in 1902 when Williams reported it [as var. *pilifera* (Brid.) Broth.] from Dawson in Yukon: Centr. Yukon R. In 1954 Steere mentions it for arctic Alaska without locality in a table on the distribution of Arctic bryophytes.

STROEMIA OBTUSIFOLIA (Bruch) Hag. McKinley Bar, on *Populus balsamifera*, with *Orthotrichum consimile* and *O. speciosum*, *W* 10444.

TAYLORIA FROELICHIANA (Hedw.) Mitt. Mt. Eielson, *W* 10007, very rare, on underhang of tundra creep terrace. New to Alaska-Yukon. Grout's flora gives the distribution as: "British Columbia, Columbia Valley, Rocky Mountains." Steere has told us that he has collected the species, although very rarely, in Alaska.

TAYLORIA LINGULATA (Dicks.) Lindb. McKinley Bar, in depressions with *Meesia uliginosa* and *Fissidens osmundioides*, *W* 10350A; Muldrow Glacier, shore of small pothole, *V* 1299; Mt. Eielson, with *Encalypta alpina*, *W* 10046. Only reported from two localities in Alaska, both in Centr. Pacific Coast (Cardot & Thériot, 1902; Harvill, 1950), and one in Yukon: Upper Yukon R. (Williams, 1902).

TETRAPLODON ANGUSTATUS (Hedw.) BSG. Wonder L. (Sherrard, 1957).

TETRAPLODON MNIOIDES Hedw. Polychrome Pass and Sanctuary-Teklanika Rivers (Harvill, 1947b); Triple L. and Wonder L. (Sherrard, 1957); Mt. Eielson, *W* 10232, 10261; Thoroughfare R., *W* 10001, 10184; Wonder L., *W* 10423; Lake Chelatna, *V* 1068A (on moose antler in bog); Kahiltna Glacier, *V* 1062A. This is the most abundant of the coprophilous mosses in the higher tundra areas. On Mount Eielson, however, *T. paradoxus* was found almost as often as *T. mnioides*, and a few times the two species were associated on the same scat, an observation of great interest (see under next species).

TETRAPLODON PARADOXUS (R.Br.) Hag. Mt. Eielson, *W* 10254, *V* 1144, *V* 1171; Lake Chelatna, *V* 1045. This critical species was reported for the first time for Alaska (Arctic Coast) by Persson (1954) who recently (Persson & Gjaerevoll, 1957) discussed its systematic rank in connection with the report of two localities for the species in Centr. Yukon R. Weber's most interesting observation that this species sometimes grows on the same scat with *T. mnioides* supports the opinion expressed by Persson that *T. paradoxus* is a species of its own. Its distribution type is decidedly arctic. In Grout's *Flora*, where it is only noted in passing, it is reported only from Greenland.

TETRAPLODON URCEOLATUS (Brid.) BSG. Kantishna and Wonder L. (Sherrard, 1957); Kantishna, on dry barren schist soil at the summit of Quigley Hill, 3000 ft., 16.8.1957, *Shacklette* 4430, *c.fr.*

THUIDIUM RECOGNITUM (Hedw.) Lindb. Kantishna, *W* 10376. This continental species is before known only from three localities in Alaska [two in Centr. Yukon R. (Persson, 1949; Sherrard, 1955) and one in Bering Strait (Persson, 1949)] and two in Yukon: Upper Yukon R. [Persson (1949) by error listed under Lower Yukon R., which is in Alaska].

TIMMIA AUSTRIACA Hedw. Carlo, on silt; bank of Nenana R. (Sherrard, 1957); Thoroughfare R., with *Climacium*, beside a brook, under *Salix*,

W 10131B, 10132 *p.p.*, with *Philonotis tomentella* and *Brachythecium nelsonii.*

TIMMIA NORVEGICA Zett. Kantishna (Sherrard, 1957).

TOMENTHYPNUM NITENS (Hedw.) Loeske. [*Camptothecium nitens* (Schreb.) Schp.] Savage R. (Persson & Gjaerevoll, 1957); Triple L. and Wonder L. (Sherrard, 1957); near center of north boundary, *Moxia* (Persson, *in litt.*); McKinley Bar, *W* 10341, 10358 *p.p.*, with *Orthocaulis quadrilobus.*

TORTELLA FRAGILIS (Drumm.) Limpr. Muldrow Glacier, around pothole, *V* 1296C; Kantishna, *W* 10389A.

TORTELLA INCLINATA (Hedw. *fil.*) Limpr. [*Barbula inclinatula* C.M. & Kindb.; *Tortella inclinatula* (C.M. & Kindb.) Broth.] Thoroughfare R., on gravel bar, *W* 10149. New to North America. DISTRIBUTION: North America: British Columbia and Alaska; Europe: widely distributed from the lowland up to the alpine region (see below); Caucasus; Asia: Persia.

On studying the type of *Barbula inclinatula* C.M. & Kindb. (from Revelstoke in British Columbia, May 27, 1890, *J. Macoun*), I could not find any differences at all between this and *Tortella inclinata;* therefore, *Barbula inclinatula* must be included as a synonym of that species. Following his description Kindberg (in Macoun 1892) states that *inclinatula* "resembles rather the European *Barbula inclinata* (Hedw. *f.*) than *B. tortuosa,* which has a larger capsule, longer leaves, taller stems, etc." Nothing is said about the difference between *inclinatula* and *inclinata.* In his flora of Europe and North America (1896-97), Kindberg places *inclinatula* immediately after *inclinata* and points out the following differences: "leaves [in *inclinatula*] as in the last [*inclinata*] but nearly straight when moist and more involute above, the perichaetial whitish, much broader. Capsule narrow-cylindric not large, nearly straight [for *inclinata* he gives 'capsule shorter (than in *tortuosa*)], suboblong, often curved, teeth much contorted [*inclinata* less contorted (than in *tortuosa*)]. Tufts loosely cohering, about 0.5 cm. high [*inclinata:* 'tufts dense . . . not high']." As already stated, it is impossible to find any real differences. Concerning the sporophytic characters, all the capsules in the type (Kindberg's herbarium in Naturhistoriska Riksmuseet, Stockholm) are quite unripe so that it is impossible to state anything about the size or form of the capsule to say nothing of the condition of the peristome.

In Kindberg's herbarium there is still another locality for *inclinata.* It is named by Kindberg *Barbula inclinatula* and the locality is "British Columbia: Laggan, earth, 5200 ft., 27.6.1904, *Macoun.*" It is sterile. From exactly the same locality Kindberg has a specimen which he has named *Barbula inclinata,* but this belongs to *Tortella fragilis* (*Drumm.*) Limpr.

Haring, who treated *Tortella* in Grout's *Flora,* states: "This species is said to be like the European *Barbula inclinata* (Hedw.)"—which is so to say a citation from Kindberg. She does not discuss the relationship between these two species but compares *inclinatula* only with *T. caespitosa* and *T. flavovirens.*

It is possible that there are more localities for *inclinata* in North America. Under *T. inclinatula* Haring cites "National Museum of Canada 105 Ont., 114 Alta., Ontario, Moxley." Of course these specimens which are not represented in Kindberg's herbarium must be carefully restudied.

Tortella inclinata is, as other species of the genus, a calciphile. It grows on calcareous banks and rocks in exposed sunny places. In the Alps it goes up to 2470 m. in the alpine region, but in northern Europe it is con-

fined to the lowland. It seems to avoid more oceanic regions and is perhaps best treated as subcontinental.

TORTULA MUCRONIFOLIA Schw. Kantishna, on talus slope above Red Top Mine on barren soil derived from quartz muscovite schist, ca. 2100 ft., 15.8.1957, *Shacklette* 4799, *c.fr.* Reported previously from one locality each in W. Pacific Coast, Bering Sea, Bering Strait and in Yukon: Centr. Yukon R. (see Persson, 1952a).

TORTULA NORVEGICA (Web. *fil.*) Wg. Thoroughfare R., with *Climacium*, beside brook, under *Salix*, *W* 10131A; Savage R. (Persson, 1952a).

TORTULA RURALIS (Hedw.) Schw. Kantishna (Sherrard, 1957); Sanctuary-Teklanika Rivers (Harvill, 1947); Mt. Eielson, around an eagle perch, *V* 1189.

TRICHOSTOMUM CUSPIDATISSIMUM Card. & Thér. Savage R. (Persson, 1952a).

ULOTA CRISPA (Bern.) Grout [*U. curvifolia* (Wahl.) Brid.] Kantishna, on surface of exposed granite boulder, mountainside by Frank Bonnell's mine at junction of Eldorado and Reinhart Creeks, ca. 2100 ft., 28.8.1957, *Shacklette* 4564, 4568. Sherrard (1955) reported this species from Walker Lake in Centr. Yukon R. as new to Alaska. Grout (1946) gave the distribution as British Columbia, Ontario, Labrador, Newfoundland and Europe. To this may be added Greenland and Siberia, where it has been recently reported from Altai, at the Yenisej R., and in the Chitin district (Bachurina, 1939).

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MOSSES OF HARLAN COUNTY, KENTUCKY

CHARLES J. FELIX[1]

This report on the occurrence of mosses from a section of southeastern Kentucky consists of specimens collected over a period of several years by the author during visits to his home in the area. The collections from eastern Harlan County are most numerous, yet are by no means complete.

There are few published records of Kentucky mosses, and the list of Fulford and Shacklette (1942) is the most extensive. They listed 169 species and 14 varieties or forms, but three of these were reported from Harlan County and represent the only published records of mosses from that county. These are *Bryum bimum* Schreb., *Brotherella recurvans* (Mx.) Fl. and *Neckera pennata* Hedw. Other published lists are by Short (1837) and Smith (1927), and more recently Crum (1954, 1956) has made several additions to the moss flora of the state.

The area investigated is in the Cumberland Mountains and is largely a luxuriant deciduous forest region which includes Pine and Black Mountains. However, the pine vegetation of Pine Mountain stands out in strong contrast to the rest of the area. The crest of Pine Mountain has an elevation of 2600 to 2800 feet in the eastern part of the county treated in this paper. On the eastern edge of the county rises Big Black Mountain with elevations 1000 feet in excess of Pine Mountain and clothed throughout with deciduous forests, interrupted only by hemlocks on its lowest slopes. Big Black Mountain attains its greatest height of 4150 feet at "The Doubles," and here the relief exceeds 2500 feet. The Poor Fork of the Cumberland River occupies the valley floor between Pine and Black Mountains.

The contrasting vegetation of the area and the considerable relief promise a varied bryophyte flora, and Braun (1935) has noted that within a limited area on Pine Mountain there are more different plant communities and more contrasts between communities than in all the rest of the Cumberland Mountains.

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This short list contains 41 species arranged according to the check-list number of THE BRYOLOGIST. The following six species, marked in the list with an asterisk, are recorded here for the first time for Kentucky: *Andreaea rothii* Web. & Mohr. *Pogonatum brachyphyllum* (Mx.) P. Beauv. *Dicranodontium denudatum* (Brid.) E. G. Britt. *Tortella humilis* (Hedw.) Jenn. *Weissia controversa* Hedw. *Hygroamblystegium orthocladon* (P. Beauv.) Grout.

Thanks are due Dr. Winona Welch for the determination of *Fontinalis* and to Dr. Lewis E. Anderson and Dr. A. J. Sharp for assistance with other determinations. One collection of each species has been deposited in the herbarium of the University of Tennessee, the moss herbarium of The American Bryological Society, and in the collections of the author.

ANDREAEACEAE

*ANDREAE ROTHII Web. & Mohr. Moist sandstone cliff face, at Raven's Rock, east of Cumberland on Pine Mountain (60).

POLYTRICHACEAE

ATRICHUM ANGUSTATUM (Brid.) BSG. Moist humus of shaded woods, north of Lynch on Black Mountain (15). Smith (1927) reported *Catharinea angustata* Brid. from Kentucky but with no locality data other than the mountain district.

*POGONATUM BRACHYPHYLLUM (Mx.) P. Beauv. Moist embankment of old logging road, one-half mile east of Cumberland on Pine Mountain (47).

POGONATUM PENSILVANICUM (Hedw.) Par. Steep, wet clay bank of mountain creek, in No. 5 Hollow, north of Lynch on Black Mountain (11).

POLYTRICHUM COMMUNE Hedw. Wet sandstone ledge, at Raven's Rock, east of Cumberland on Pine Mountain (55).

POLYTRICHUM OHIOENSE Ren. & Card. Decaying log, moist, shady woods, north of Lynch on Black Mountain (17). Moist bank of Looney Creek, east of Lynch (23).

DICRANACEAE

*DICRANODONTIUM DENUDATUM (Brid.) E. G. Britt. Same as above (55, 61).

DICRANELLA HETEROMALLA (Hedw.) Schimp. Same as above (17, 14).

DICRANUM FULVUM Hook. Sandstone boulder in shady woods, northeast of Lynch at base of Black Mountain (5). Rocks along creek in No. 5 Hollow, north of Lynch on Black Mountain (45).

LEUCOBRYACEAE

LEUCOBRYUM ALBIDUM (Brid.) Lindb. Moist humus along mountain creek, in No. 5 Hollow, north of Lynch on Black Mountain (6).

BUXBAUMIACEAE

DIPHYSCIUM FOLIOSUM (Hedw.) Mohr. Moist sandstone boulder in mountain stream in No. 5 Hollow (16). Steep, well-drained slope in *Kalmia latifolia* thicket, north of Lynch on Black Mountain (40). Along trail near old cabin, below Raven's Rock, east of Cumberland on Pine Mountain (65).

POTTIACEAE

*TORTELLA HUMILIS (Hedw.) Jenn. Moist soil of pasture in No. 5 Hollow, north of Lynch on Black Mountain (41).

WEISIA CONTROVERSA Hedw. Dry soil as base of *Populus* in pasture in No. 5 Hollow, north of Lynch on Black Mountain (44).

GRIMMIACEAE

GRIMMIA APOCARPA Hedw. Rocky ledge above the "Big Rock," right fork of No. 1 Hollow, north of Lynch on Black Mountain (34).

GRIMMIA PILIFERA P. Beauv. Dry sandstone along mountain creek, in No. 5 Hollow, north of Lynch on Black Mountain (12). Lichen encrusted sandstone ledge above the "Big Rock," right fork of No. 1 Hollow, north of Lynch on Black Mountain (38).

HEDWIGIA CILIATA (Hedw.) P. Beauv. Abundant on sandstone outcrops, one-half mile east of Cumberland on south slope of Pine Mountain (54).

PTYCHOMITRIUM INCURVUM (Muhlenb.) Sull. Dry soil at base of stump, one-half mile east of Cumberland near top of Pine Mountain (56).

FUNARIACEAE

PHYSCOMITRIUM TURBINATUM (Mx.) Brid. Dry soil along mountain trail, one-half mile east of Cumberland on south slope of Pine Mountain (46).

ORTHOTRICHACEAE

DRUMMONDIA PROREPENS (Hedw.) Jenn. Bark of *Carya*, summit of steep ridge above No. 6 Camp, northeast of Lynch on Black Mountain (4). Bark of *Carya* in right fork of No. 1 Hollow, north of Lynch on Black Mountain (33).

ORTHOTRICHUM OHIOENSE Sull. & Lesq. Trunk of *Quercus* in pasture in No. 5 Hollow, north of Lynch on Black Mountain (43).

ULOTA AMERICANA (P. Beauv.) Limpr. Sandstone boulder in shady woods, northeast of Lynch on Black Mountain (2). Dry standstone at cave entrance, on Raven's Rock, east of Cumberland on Pine Mountain (48).

AULACOMNIACEAE

AULACOMNIUM HETEROSTICHUM (Hedw.) BSG. Moist bank of Looney Creek, east of Lynch (29).

AULACOMNIUM PALUSTRE (Web. & Mohr.) Schwaegr. Wet sandstone ledge above cave entrance, on Raven's Rock, east of Cumberland on Pine Mountain (53).

BARTRAMIACEAE

BARTRAMIA POMIFORMIS Hedw. Moist, trailside ledge near small dam below Raven's Rock, east of Cumberland on Pine Mountain (50).

BRYACEAE

BRYUM PSEUDOTRIQUETRUM (Hedw.) Schwaegr. Sandstone boulder on bank of Looney Creek (24). Sandstone boulder in bed of Looney Creek (25). Both collections at mouth of Magazine Hollow, east of Lynch.

RHODOBRYUM ROSEUM (BSG.) Limpr. Wet soil along trail near small dam below Raven's Rock, east of Cumberland on Pine Mountain (51).

MNIACEAE

MNIUM AFFINE Bland. Wet bank of stream at cave entrance, on Raven's Rock, east of Cumberland on Pine Mountain (52).

MNIUM CUSPIDATUM Hedw. On bank of Looney Creek, one-fourth mile east of Magazine Hollow, east of Lynch (*26*).

HYPNACEAE

BRACHYTHECIUM SALEBROSUM (Web. & Mohr) BSG. Decayed stump, summit of Black Mountain above No. 5 Camp, north of Lynch (*39*).

CLIMACIUM AMERICANUM Brid. Same as above (*26, 27*).

ENTODON SEDUCTRIX (Hedw.) C.M. Sandstone boulder in shady draw near springhouse in No. 5 Hollow, north of Lynch on Black Mountain (*30*). Wet sandstone boulder near top of mountain, on right fork of No. 1 Hollow north of Lynch on Black Mountain (*36*).

EURHYNCHIUM SERRULATUM (Hedw.) Kindb. Moist humus near summit of steep ridge above No. 6 Camp, northeast of Lynch on Black Mountain (*3*). Decayed log, same as above (*3, 32*). Dead chestnut, summit of mountain (3500 ft.), in right fork of No. 1 Hollow, north of Lynch on Black Mountain (*37*).

HOMOMALLIUM ADNATUM (Hedw.) Broth. Sandstone boulder in bed of mountain creek, in No. 5 Hollow, north of Lynch on Black Mountain (*10*). Moist, streamside boulder above No. 6 Camp, northeast of Lynch on Black Mountain (*22*).

*HYGROAMBLYSTEGIUM ORTHOCLADON (P. Beauv.) Grout. Sandstone boulder in bed of mountain creek, northeast of Lynch on Black Mountain (*21*). Moist, roadside bank, along highway one-half mile east of Lynch (*28*).

HYPNUM CURVIFOLIUM Hedw. Decayed log in moist, shady woods, north of Lynch on Black Mountain (*18*).

HYPNUM IMPONENS Hedw. Decayed log in shaded woods, along mountain creek in No. 5 Hollow, north of Lynch on Black Mountain (*7*).

PLAGIOTHECIUM DENTICULATUM (Hedw.) BSG. Among *Fagus* roots on moist bank of mountain creek, north of Lynch on Black Mountain (*20*).

LESKEACEAE

THUIDIUM DELICATULUM (Hedw.) Mitt. Decayed log, northeast of Lynch on Black Mountain (*1*). Moist humus along mountain creek in No. 5 Hollow, north of Lynch on Black Mountain (*8*). Wet cliff on east facing ridge, north of Lynch on Black Mountain (*31*).

LEUCODONTACEAE

LEUCODON JULACEUS (Hedw.) Sull. Bark of *Quercus,* above the "Big Rock," right fork of No. 1 Hollow, north of Lynch on Black Mountain (*35*).

FONTINALACEAE

FONTINALIS NOVAE-ANGLIAE Sull. In stream at cave entrance, on Raven's Rock, east of Cumberland on Pine Mountain (*49*).

SPHAGNACEAE

SPHAGNUM SUBSECUNDUM Nees. Wet cliff face west of cave entrance (*59*). Wet ledge above cave entrance, on Raven's Rock, east of Cumberland on Pine Mountain (*64*).

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PORELLA PINNATA IN MICHIGAN

WILLIAM J. GILBERT[1]

During a field trip with students on May 4, 1958, we found *Porella pinnata* L. attached to submerged rocks and other materials in a stream flowing through Camp Mahngotahsee at Loon Lake in Iosco County about three miles north of Hale, Michigan. (Thanks are due Dr. Margaret Fulford and Dr. A. J. Sharp for confirming the identification.) Since this liverwort was present in abundance at this particular station and since to my knowledge it has not been included in any published lists or manuals of liverworts of the lower peninsula, I became interested in checking its reported distribution in Michigan. Its occurrence in surrounding states suggested that it should be found fairly commonly.

Kauffman (1915) reported *Porella pinnata* from Lapeer (Lapeer County), but this report is not supported by specimens in the University of Michigan herbarium, and Steere (1934) has indicated that the material reported as *P. pinnata* was probably *P. platyphylloidea* (Schwein.) Lindb. Frye and Clarke (1946) referred to Kauffman's record but examined no material from Michigan.

The only authentic published records of *Porella pinnata* in Michigan appear to be those by Nichols (1935, 1938), who collected it in the Huron Mountain region in Marquette County in Michigan's upper peninsula. These reports are supported by the only specimens of *P. pinnata* from Michigan (three in all) in the University of Michigan herbarium. Dr. John Reeder has written that there are three collections from Michigan in the Herbarium of Yale University, all made by Nichols in the Huron Mountain region. The data indicate at least two and possibly all three of the

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collections at Yale are duplicates of those at Michigan. *P. pinnata* is included by Steere (1947) in the last extensive published list of Michigan bryophytes, but its inclusion was based, probably, on the Huron Mountain material. (Dr. William C. Steere has written that he has also seen *P. pinnata* on Mackinac Island.)

Interestingly, *Porella pinnata* is included in an unpublished list of bryophytes "found within 25 miles of Douglas Lake" compiled by Nichols when at the University of Michigan Biological Station. There are no specimens of *P. pinnata* in the biological station herbarium (information supplied by Dr. Howard Crum), however, and it is not included in any of the published lists or manuals that include liverworts from that area.

Despite the evidences that suggest it is not an uncommon species in Michigan, this report of *Porella pinnata* L. from Iosco County appears to be the first authentic record of its presence in Michigan's lower peninsula.

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THE STATUS OF USNEA DIPLOTYPUS IN NORTH AMERICA

MASON E. HALE, JR.[1]

In a recent article J. W. Thomson (1956) discussed the occurrence of *Usnea diplotypus* Vain. in North America. One of the specimens cited by him was issued in *Lichenes Americani Exsiccati* (no. 32) as *U. subfusca* Stirt., determined after J. Motyka (*cf.* Hale, 1956). This conflict in determinations led the writer to examine the holotype of *U. diplotypus* (FINLAND: Pahaniemi near Abo, *E. A. Vainio,* herbarium no. 530, TUR), as well as the specimens cited by Thomson (WISC).

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The holotype and two other authentic specimens of *Usnea diplotypus* from Finland (Kotiluoto, *E. A. Vainio,* herbarium no. 104, TUR; Heposaari, Rantakallioilla, Kurkijoki, *V. Räsänen,* TUR) differ significantly in several respects from the North American population which Thomson has fully described. The European plant has a narrowed black base up to 1 cm. long and an attenuated thallus 5-12 cm. long, giving it the appearance of a large thin specimen of *U. comosa* (Ach.) Röhl. The American plants have a normal concolorous base and a crowded tufted thallus rarely more than 5 cm. long. The two populations also differ chemically, although both react KOH + red in the medulla. *Usnea diplotypus* from Europe contains salacinic and usnic acids, whereas the *Usnea* from North America always produces norstictic and usnic acids, as proved with the G. A. o-T. microchemical test.

It is evident that the North American population cannot be identified with the *Usnea diplotypus* of Europe. The exact status of our species, however, cannot be established until the type of *U. subfusca* Stirt. in the British Museum is studied. For the present it is desirable to use the name *U. subfusca* suggested by Motyka, the chief authority on the genus *Usnea,* even though it may ultimately be found incorrect.

The following specimens preserved in the U. S. National Museum (all collected by Hale) can be added to those cited by Thomson, which the writer has verified. WEST VIRGINIA: Grant County, 12315; Pendleton County, 10047. VIRGINIA: Highland County, 10437; Warren County, 14840. ALABAMA: Shelby County, 7157. ARKANSAS: Conway County, 3388; Franklin County, 3657; Logan County, 3422; Polk County, 3940; Washington County, 4038; Yell County, 3202. OKLAHOMA: Carter County, 4852. These additional records indicate that *U. subfusca* is a not uncommon species on exposed sandstone and shale cliffs throughout the southeastern United States.

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A NEW SOIL-BINDER FOR PRESERVING LICHEN SPECIMENS

BURTON N. GATES[1]

Soil-supported lichens, such as *Baeomyces roseus* Pers., are difficult to preserve without treating the soil to prevent raveling and the consequent break-up of the specimen. Various glues are available in the stores, but most of them have disadvantages and inefficiencies. Some became tacky in humid weather; some fail to penetrate sufficiently into our soils to form a binder or casing which will withstand handling.

A chance inquiry brought fortunate correspondence with Mr. Francis Schofield, Chief of the Technical Division of the National Paint, Varnish and Lacquer Association of Washington, D. C. He strongly urged not to consider glues made from "natural materials," most of which are water sensitive and attract various kinds of destructive insects, bacteria and molds. In their stead, he proposed investigating the new synthetic resin adhesives which might better solve the problem of encasing the troublesome soil collected with lichen specimens. As a source of such adhesives, addresses of several progressive manufacturers were supplied.

The writer is especially grateful to Rohm and Hass Company, Washington Square, Philadelphia 5, Pennsylvania, for their unstinted assistance. The first inquiry to them, detailing the problem of a soil-binder and what it was hoped to accomplish in the preparation of our lichen specimens for preservation, seemed to have stumped the experts. Apologizing for a delayed answer, their encouraging reply continued, ". . . your inquiry is a little unorthodox; it has passed through several hands in our company." Doubtless so! It has been said, that chemists and biologists each speak a language of their own and are gradually becoming unable to understand one another. Nevertheless, Rohm and Hass Company spoke with understanding, sent a sample of their "Rhoplex AC-33" to be tried out and intimated that if it did not do the job, they might have something else to suggest. Fortunately, from the first preliminary trials the Rhoplex showed promise.

For about a year, various means of using the Rhoplex were tested. Gradually it was learned what manipulation was to be avoided and how best to apply, to dry and to harden the Rhoplex casing. As furnished by the manufacturer, Rhoplex emulsion may be thinned with water. It took many trials to determine what may be the optimum consistency to encase soils such as occur in

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this area. Rhoplex AC-33 has proved so adaptable and so satisfactory as a soil-binding material in the Hadwen Herbarium of Worcester County Plants, that the writer is pleased to recommend it to lichenologists.

Although Rohm and Hass Company supplied the material used by the writer, they are not in a position to supply Rhoplex AC-33 in small quantities such as may be desired by botanists. This reflects the fact that their markets are industrial, where a fifty gallon drum is the standard container. However, they have arranged with Masco Chemical Company, 50 John Hay Avenue, Kearney, New Jersey, to supply Rhoplex in small quantities. Botanists should order their supplies from Masco Chemical Company.

Rhoplex AC-33, as explained by the manufacturer, is a white liquid, of relatively high viscosity, dilutable with water according to the user's requirement. Although appearing white in liquid form, it air-dries promptly to an apparently clear and transparent coating. Drying is not so rapid as to inconvenience practical manipulation. Chemically, it is a new arcylic resin emulsion, somewhat related to Plexiglas. Chemically stable and inert, it is anticipated to be durable, a quality which is desired in lichen herbaria. The manufacturers suggested that dried Rhoplex may have a slight tack, but the writer has not detected this to be a disadvantage.

Procedure has been learned by trial and error. At first, it was thought practical to dip the prepared lichen soil-clods into a shallow dish of Rhoplex, placing the dipped specimens to dry on a plate of glass. That process works reasonably well with a group of specimens of about equal thickness of soil. However, it has been found difficult to dip specimens to exactly the right depth to cover the side walls of the soil-clod; clods vary in thickness and may be thicker on one edge than on the other. It was soon learned that specimens of different sizes, thicknesses and shapes could be handled more readily and perhaps more quickly, by painting the Rhoplex directly onto the soil with a camel's hair brush (about a number 4 brush); this has the advantage of allowing the operator to determine that the Rhoplex is properly penetrating the soil, evenly and sufficiently. Experience will determine when the coating is proceeding satisfactorily. The writer usually paints the sidewalls of the soil-clod first and the under surface last, filling any pits or depressions. Specimens when painted are laid out to dry, painted-side up, on a sheet of glass. Rhoplex soon sets, but the specimens are allowed to dry thoroughly throughout the soil-clod, usually over night. Occasionally a painted specimen may be placed

soil-side down; it will adhere to glass but is usually removed with ease when completely dry, by slipping a safety-razor blade under it.

Once the painting of the soil-clods has commenced, it must proceed smoothly and continuously without any delays, until all of the prepared Rhoplex is used. Otherwise, it will tend to thicken and perhaps dry in the container along its edges. It is assumed that the specimens have been shaped and trimmed as desired in advance. Experimenting with Rhoplex, the writer used as a suitable subject, the prevalent *Baeomyces roseus*. With it, a most satisfactory means of reducing the thickness of the soil-clod was devised. There is little substance to *Baeomyces* specimens; they easily crumble. After preliminary shaping of the specimen, the clod can be readily reduced in thickness by slowly, gently and lightly rubbing it over a roughish piece of paper, such as towel paper. A few strokes may be sufficient. If a small stone is encountered, remove it. When treated with Rhoplex, these surprisingly thin specimens become as firm and solid as a tablet of sugar.

Soils appear to differ in absorbing the Rhoplex. The material sinks faster and seemingly deeper into some specimens than into others. This may be due in part to the density and viscosity of the emulsion. A slight dilution of the Rhoplex seems to give deeper and quicker penetration. A medicine dropper is convenient to remove the Rhoplex (be sure it is well stirred) from the stock jar for dilution. The writer finds particularly serviceable a round-bottomed, small glass dish (called in laboratory supply catalogs an embryological cup). The dilution with water may be readily estimated with the medicine dropper. A maximum of 25% dilution with water appears correct for most specimens. The operator will soon discover how much of the dilution to prepare, to be completely used before the Rhoplex begins to set. When not in use, the medicine dropper and brush should stand in a beaker of water. It is important also, when finished with the instruments, that they be promptly soaked and thoroughly washed. The brush in particular needs to be washed until no Rhoplex remains in the base of the bristles, where it may harden and spoil the brush. If the stock jar is kept tightly closed there has been no apparent skimming of the liquid or any deterioration of it.

Lichen specimens in the Hadwen Herbarium of Clark University are filed in the customary folded envelope. All specimens as far as possible (excepting species which must be examined from beneath) are cemented to cards. Soil-encased specimens (as well as lichens on rock) are fastened on the cards with Duco cement. The use of this adhesive was approved by the manufacturers of

Rhoplex, who commented that "the Duco cement should give excellent adhesion to the Rhoplex AC-33 surface. The solvent present in the Duco will soften the acrylic film of the Rhoplex AC-33 somewhat, and on drying the bond will again become strong. This would aid the adhesion between the 'Duco' and 'Rhoplex' sections of the specimen."

THE SEXUAL BRANCHES OF ACROMASTIGUM BANCANUM

JANE TAYLOR[1]

In the Stephani Herbarium (G) there is a specimen (no. 172), collected by Franc in New Caledonia and determined as *Lepidozia adaptata* Stephani, which belongs to the genus *Acromastigum*. It has affinities with *A. bancanum* (Sande Lac.) Evans but differs in the following details: 1. The cells have well-developed tubercles as opposed to being non-tuberculate. 2. The leaf-apex is obtuse terminating in two cells (FIG. 21), occasionally in a single cell as opposed to "normally acute and tipped with a single cell or with two cells in a row" (Evans 1934, p. 22). 3. The underleaves are subentire with one or two depressions—occasionally the sinus is sufficiently deep to recognize a bifid condition (FIG. 22, 23)—as opposed to "many underleaves are entire throughout but some show, at the apex, one or two slight depressions or other similar irregularities" (Evans 1934, p. 23). The tuberculate condition may well be a modification due to environmental factors; the apices of the leaves show a transition series while the difference in the underleaves is really a difference of degree.

The above cited specimen may prove to be a distinct species but until it is better known in the field and more collections are available it should for the present be referred to *A. bancanum*. The latter is one of the three species included by Evans (1954, p. 20) in his section Exilia, all members of which are known only in the sterile condition. The purpose of this paper is, therefore, to describe the sexual branches of *A. bancanum* basing the description on the above cited collection (*Franc* 172).

The plants are dioicous with the sexual organs developed on special branches. The sexual branches are ventral and intercalary arising in the axils of the underleaves and on the flagelliform branches.

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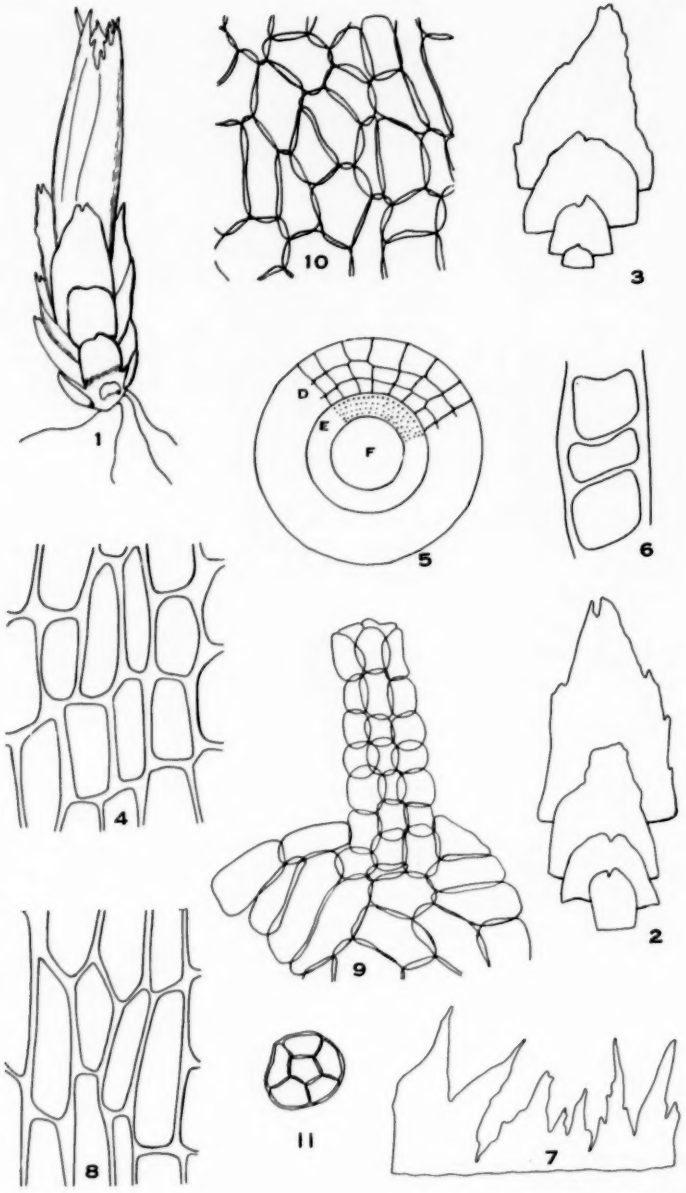
Female Branch

Two female branches were available for study. The female branch (Fig. 1) is more or less radially symmetrical with rhizoids produced sparingly at the base and with the bracts and bracteoles arranged in four series (Fig. 2, 3). The bracts of the innermost series are ovate-lanceolate in outline and measure 0.9-1.2 mm. in length by 0.35 mm. wide at the base. They are shortly bifid with triangular divisions tapering to 1-2 cells at the tip and with the lateral margins irregularly dentate (Fig. 13). The bracts of the next outer series are a little shorter than those of the innermost series, with shorter divisions or they may be subentire. The bracts of the next series are subentire and broadly ovate in outline. The bracts of the outermost series are still smaller measuring only 0.19 mm. in length by 0.24 mm. wide at the base. The bracteoles are similar to the bracts but smaller. The cells are rectangular with slightly thickened walls, the median 352-435 μ in length by 90 μ in width (Fig. 4).

The perianth conforms to the hypogonianthous type showing three rounded keels in the upper part and terete in the lower part. It measures 1.6-2.0 mm. in length by about 0.4 mm. in diameter. The contracted mouth is deeply laciniate (Fig. 7). The unequal laciniae are narrowly subulate, each tapering to a slender cilium composed of a single cell or of a row of 2-4 cells (Fig. 12). The margins of the laciniae are irregularly dentate from the projecting cells. The cells of the perianth from just below the laciniae (Fig. 8) are rectangular, thin-walled and measure 35-70 μ in length by 9-21 μ in width. The perianth is unistratose (Fig. 6) though scattered division walls parallel with the surface can be demonstrated towards the base.

The calyptra is unistratose with irregularly rectangular thin-walled cells, the median cells 17-35 μ in length by 21 μ in width (Fig. 10). The neck of the fertilized archegonium is composed of seven tiers of cells (Fig. 9), while a cross-section of the neck of an unfertilized archegonium (Fig. 11) shows five neck cells and a neck canal cell. The calyptra is ruptured near the apex by the developing sporophyte and at its base it is surrounded by 10-12 unfertilized archegonia. The sporophytes were not preserved.

A cross-section of the female branch near its base and just above the line of insertion of the female bracts and bracteole of the outermost series is shown semi-diagrammatically in Fig. 5. The foot of the sporophyte penetrates into the stem to a considerable depth and the medullary tissue is crushed in the process. Fig. 5f, indicates the area occupied by the tip of the foot which unfortunately was lost in the preparation of the section. Adjacent to the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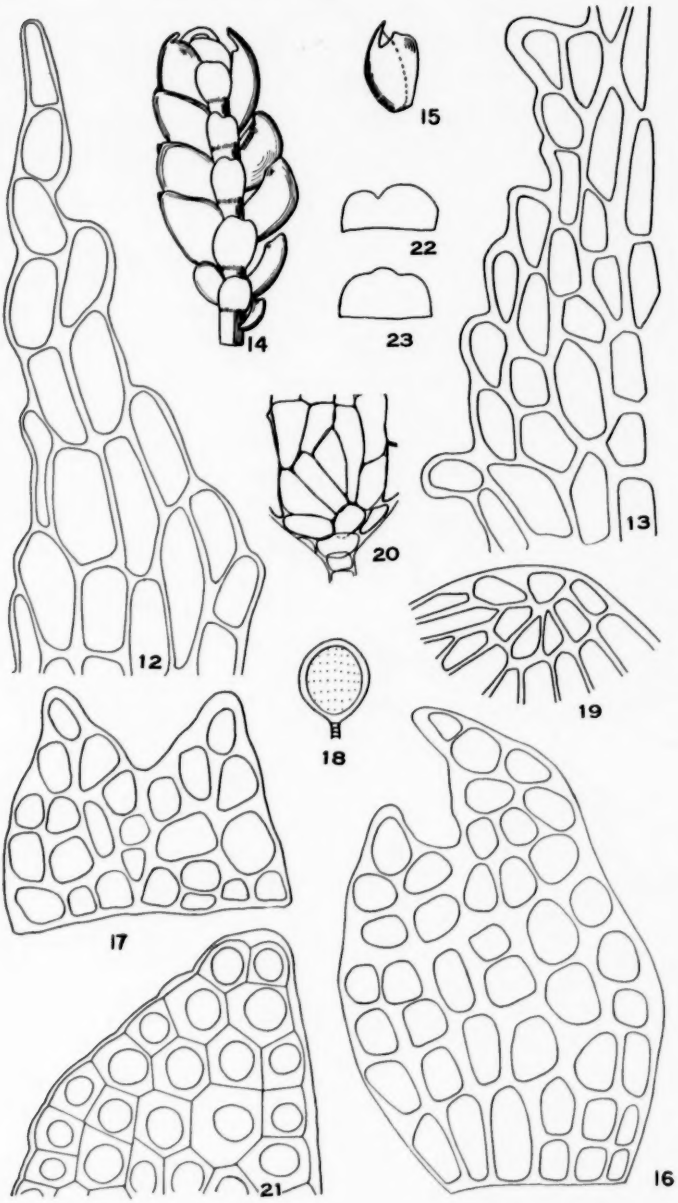
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foot is a zone of crushed tissue (FIG. 5e). The outermost zone is composed of three layers of meristematic tissue (FIG. 5d).

MALE BRANCH

Numerous male branches were available for study. The male branch (FIG. 14) is dorsiventral and attains a length of up to 1.2 mm. The imbricated monandrous bracts are in 3-10 pairs. They are inflated and unequally bifid, the divisions acute or acuminate (FIG. 15). The flattened bract (FIG. 16) is 0.23 mm. in length and 0.09 mm. wide at the base. It is ovate in general outline with the ventral division smaller than the dorsal and both divisions tipped with a single cell. The bracteoles are smaller than the bracts and slightly convex. The bracteole (FIG. 17) is quadrate in general outline and subequally bifid to 1/3, with triangular divisions and a lunulate sinus. The cells are quadrate (rectangular at the dorsal base of the bract), the median cells 18-23 μ in length by 15-20 μ in width with slightly thickened walls. The antheridia occur singly in the axils of the bracts.

The antheridium (FIG. 18) is orbicular and averages 113 μ in diameter. The antheridial wall is composed of one layer of delicate thin-walled cells which are somewhat irregularly arranged towards the base (FIG. 20) and in definite rows towards the apex (FIG. 19). There is an apical dehiscence. The stalk of the antheridium is more than four cells long (the exact number of cells was not ascertained) and one cell in width.

Though the sexual branches still remain unknown in the majority of the species of *Acromastigum*, those of *A. bancanum* support the theory (Evans, 1934, p. 16) that they are apparently more uniform than the vegetative branches.

FIG. 1-11. *Acromastigum bancanum*. 1. Female branch, × 30. 2. One series of female bracts, × 58. 3. One series of female bracteoles, × 58. 4. Median cells of the female bract, × 375. 5. Cross-section of the female branch above the outermost series of perichaetial leaves, × 92; d, outer meristematic zone; e, zone of crushed medullary tissue; f, area occupied by tip of foot. 6. Cross-section of perianth about 1/3 from the apex, × 375. 7. Laciniae at the mouth of the perianth, × 58. 8. Cells of the perianth from below the laciniae, × 375. 9. Apical portion of the calyptra with the neck of the archegonium, × 375. 10. Median cells of the calyptra, × 375. 11. Cross-section of the neck of an unfertilized archegonium, × 375.

FIG. 12-23. *Acromastigum bancanum*. 12. Tip of a perianth lacinia, × 375. 13. Cells from the margin of the female bract, × 375. 14. Male branch of medium length, × 83. 15. Male bract, × 92. 16. Male bract flattened out, × 375. 17. Male bracteole, × 375. 18. Antheridium, × 92. 19. Apical portion of the antheridium, × 375. 20. Basal portion of the antheridium, × 375. 21. Apical portion of a leaf, × 375. 22, 23. Underleaves, × 92.

I wish to express my thanks to Dr. C. E. B. Bonner and Dr. C. Baehni for the loan of specimens from the Stephani Herbarium, Geneva, and to Dr. H. J. Lam for the loan of specimens from the Rijksherbarium, Leiden. Dr. Margaret Fulford has kindly read the manuscript.

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RESIDUAL LEAVES FROM BROOD-BRANCHES OF PHILONOTIS CAESPITOSA

Edward C. Taylor, Sr.[1]

It is recognized (Flowers, 1935a, b; Correns, 1899) that plants of *Philonotis* species often have brood-branches in the axils of their leaves. It does not seem to be noted in the published literature, however, although described by Flowers (*in lit.*, 1956), that when these brood-stems fall they may leave small leaf-like bodies attached to the stem, either single or in a bud formation, which when seen without the brood-branches are at first sight puzzling as to their origin. Apparently they are not generally known, and the writer has undertaken the preparation of illustrations which would show clearly both their origin and some of the varied forms in which they might be encountered.

It was stated by Flowers (*in lit.*, 1956) that the bodies "are the first leaves formed when the branch buds first develop. They vary in shape and size. In some instances they diverge as separate scale-like leaves and may range from rounded-obtuse to acute or even slightly acuminate. In some instances they are long enough to curve inward and over the tip of the very young bud and are analogous to the bud scales of higher plants." To show that they can remain behind after the abscission of the brood-branch a stem of *Philonotis caespitosa*, with a brood-branch still in place, was soaked in 10% glycerin which was gradually evaporated to full strength. Excess glycerin was removed on filter paper and the plant laid on a smear of partially thickened brushing lacquer on a slide. The glycerin prevented the lacquer from penetrating the tissues, so that it acted solely as an external support. By stroking carefully with a very fine brush repeatedly moistened with amyl acetate and wiped almost dry, stem leaves around the brood-branch could be freed for removal without disturbing the branch or any stem leaves it was desired to retain in place. After removing enough stem leaves to expose the base of the brood-branch, the

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latter was pulled gently by its tip a short distance away from the main stem, showing clearly the residue of leaves from the base of the branch which adhered to the stem (*fig.* 1). Excess lacquer was cleaned off with the practically dry brush, and the stem and branch secured in place on the slide by allowing the lacquer to harden. To avoid any chance of disturbing the parts, no attempt at embedding or placing a cover glass was made in this particular mount.

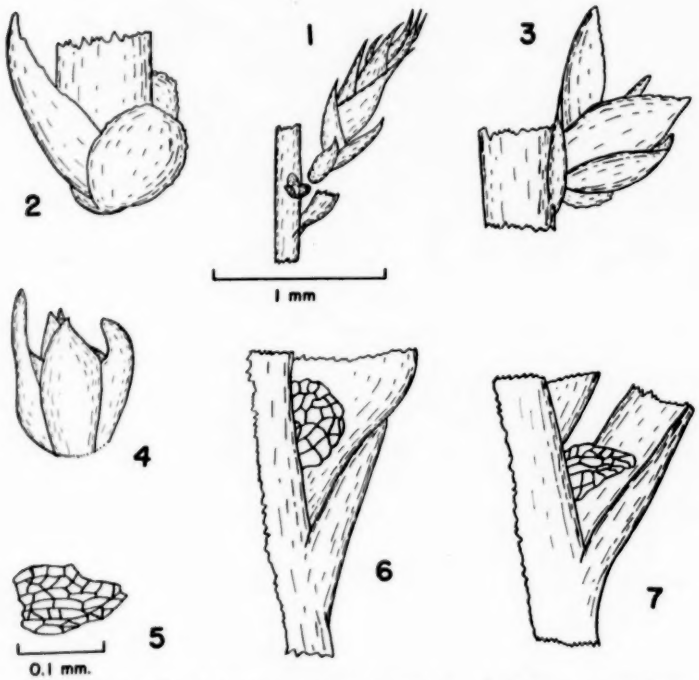

FIG. 1-7. Residual leaves from brood-branches of *Philonotis caespitosa*. Individual figures are described in the text. Fig. 1 is on the scale indicated; other figures are on the scale indicated under fig. 5.

Figure 1 (made as are the others with a camera lucida) shows one of many stems thus treated. The other figures show various forms of residual leaf assemblies with the exception of figure 2, in which the normally residual leaves remained on the brood stem, and figure 5, which shows the very irregular cell structure of one of these leaves. Individual cells have not been shown except with

single leaves on account of the confusion where leaves overlapped. It will be seen that one or several leaves may be left.

Figure 4 is of particular interest in that the group of leaves shown spontaneously parted from the stem subsequent to the falling of the brood-branch, showing the existence of more than one potential zone of abscission.

The mosses used came from the writer's land in Hartford, Vermont (just over the Woodstock line), elevation 860 feet, growing on moderately damp rocks. Determination of material used in figures 3 through 7 was made by Dr. Herman Persson and of that used in figures 1 and 2 by Mrs. Ethel P. Hutchinson, who first called these residual leaves to my attention.

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AN ARCTIC SCAPANIA FOUND IN THE CHICHIBU MOUNTAINS, JAPAN

HIROSHI INOUE[1]

Scapania cuspiduligera K. Müll., a very interesting and rare arctic species, has been known from Europe, North America and Asia (Siberia). It is very interesting that this species was found in the Ohchigawa valley of the Chichibu Mountains (139°E, 36°N) of middle Japan. Last autumn the writer had an opportunity to visit there. The valley is situated about 80 km. northwest of Tokyo, and there are many cliffs composed mainly of chert and limestone which belong to the Paleozoic. The forest along the valley is deciduous, and *Fraxinus verecunda, Fagus crenata,* and *Carpinus* spp. are among the main components of the forest.

At first, the writer thought this *Scapania* to be a new species. However, after careful study, he considered it very close to, or probably the same as *Scapania cuspiduligera.* A duplicate was sent to Dr. R. M. Schuster, for verification, and he warranted it as "typical" *S. cuspiduligera.*

This species was scarcely found in a moss patch, in which *Lophocolea itoana, Marchantia paleacea, Lejeunea japonica* and *Plagiochila hakkodensis* were also found. At the neighboring sites

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such interesting hepatics as *Lophozia* (Hattoriella) *diversiloba*, *Acrobolbus titibuensis*, *Calycularia crispula*, *Plagiochila titibuensis* and *P. rigidula* (*ms.*) were also found. The moss patch in which *Scapania cuspiduligera* grew developed on moist chert covered with thin soil, with a pH value of 6.5.

The habitat of this species in the valley is nearly the same as that in the known districts in Europe and North America. Müller (1956) described the habitat as "auf feuchten, kalkhaltigen Felsen, oder auf Felsboden," and Schuster (1949, 1953) said that "the chief requirements are a somewhat calcareous mineral substrate" and gave the pH as 6.9-7.2. Although the pH is somewhat lower in Japan, the habitat is essentially calcareous, and the above-cited calciphilous hepatics are found neighboring to, or associated with this species (especially *Lophozia diversiloba* and *Acrobolbus titibuensis*.

Compared with North American and European materials, the Japanese plant shows some differences in the cell layers of the stem cortex, the measurement of leaf cells, and the oil bodies. Frye and Clark (1946) described the cortical cell layers as 2 and the cells along leaf margin as 12-15 μ (isodiametric) and those of leaf base as 20 by 40 μ. Müller (1956) described the cortical cell layers as 1-2 and the cells along the leaf margin as 6-9 × 12-18 μ and those of the leaf middle as 15-18 × 20-25 μ. The cells in the leaf middle studied by the writer in European and North American materials are mostly 19-24 × 12-18 μ or occasionally 13 × 12 μ, and along the leaf margin they are mostly 12-16 × 10 μ. In well-developed Japanese material the cortical cell layers are mostly 3 or occasionally 2 or 4, and the leaf cells are slightly smaller than those of European and North American plants.

The oil bodies of *Scapania cuspiduligera* were described as "6-12 μ or larger, 1-3 per cell mostly" (Schuster, 1949), or as "3-4 je Zelle, kugelig, 6-8 μ gross" (Müller, 1956). Schuster (1949) placed particular stress on the oil bodies when he proposed the subgenus Buchiella for this species. In the Japanese plant, the oil bodies are a little larger and more numerous than those of European and North American plants.

The Japanese plant may be characterized as follows:

SCAPANIA (Buchiella) CUSPIDULIGERA (Nees) K. Müll. *in* Rabenh. Krypt. Fl. 6(2): 472. 1915. *Jungermannia cuspiduligera* Nees, Naturg. Eur. Leberm. 1: 180 (1933). Plants sterile, bright green, somewhat yellowish-green in the lower portion, scattered among mosses. Stem approximately 7 mm. long, 2 mm. wide with leaves, simple, reddish-brown, prostrate with ascending

apex; in cross-section cortical cells in (2)-3-(4) layers, approximately 13 × 10 μ, walls much thickened, yellowish- to reddish-brown, medullar cells variable in size, 10-20 × 17 μ, walls thin towards center, yellowish to white. Leaves approximate to imbricate, bilobed to nearly 1/4 their length, keel slightly concave dorsally, margin entire throughout, lobe rotundate to acute (especially so in the dorsal lobe), about 0.9 mm. wide and 1.0 mm. long, base closely sheathing stem; dorsal lobe almost equal to the ventral one in size, squarrose, reflexed, nearly transversally inserted, ventral lobe with a slightly decurrent base. Cells along the leaf margin 6-10 × 10-13 μ, of middle 13-20 × 10-17 μ, of base 43-47 ×13-17 μ; walls along the leaf margin moderately thickened, of middle to basal cells thin, trigones conspicuous in middle to basal cells. Oil bodies 2-5 (mostly 3-4) per cell from apical to median region, 4-7 (mostly 4-5) per cell in basal region non-homogeneous, greyish-white, mostly fusiform (4-6 × 6-8 μ, or occasionally 10 × 6 μ) or spherical (about 3 μ). Rhizoids numerous, colorless. Gemmae seen near apical part of shoot occurring on apex of leaf lobe, bicellular, approximately 10 × 16 μ, olive-brown.

LOCALITY: Ohchigawa valley (about 800 m. alt.) in Chichibu Mts., Saitama Pref., Honshu, Japan, Nov. 3, 1957, *H. Inoue* 7600, 7601, *in herb.* Tokyo Univ. Education; duplicates *in herb.* Hattori Bot. Lab. and R. M. Schuster (Univ. of Massachusetts).

The writer is deeply indebted to Dr. S. Hattori of the Hattori Botanical Laboratory for his valuable criticism and encouragement and to Dr. R. M. Schuster of the University of Massachusetts for his verification of Japanese material.

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REVIEWS

MUSCI JAPONICI EXSICCATI, Ser. 12 (nos. 551-600), edited by A. Noguchi & S. Hattori. The Hattori Botanical Laboratory, 3888 Obi, Nichinan-shi, Miyazaki, Japan. June 1957 ($7.00)—A complete list of species included in this series was published on page 119, number 18, of the *Journal of the Hattori Botanical Laboratory* for Sept. 1957. Faithful subscribers to the *Musci Japonici* will note that 24 of the 48 species represented in series 12

have not been distributed previously by Noguchi and Hattori, and that another 19 of them have been included only once before. The remaining five were distributed twice already, but of these three are restricted to Asia, apparently, and so are of special interest. Nine of the 48 species (555, 563, 565, 567, 570, 578, 582, 595, 599) could not be found listed by Brotherus in *Die natürlichen Pflanzenfamilien*, and five (557, 567, 578, 595, 598) were not in Sakurai's *Muscologia Japonica*. For those who are accustomed to the nomenclature found in the *Pflanzenfamilien* the following are given by the names used by Brotherus: 552, *Andreaea faurei;* 554, *Anomodon apiculatus;* 556, *Catharinea undulata;* 559, *Bryhnia uncinifolia;* 571, *Dicranum undulatum;* 579, *Oxyrrhynchium hians*. Only 13 of the 48 species (551, 554, 556, 566, 568, 571-574, 579, 585, 591, 594, 596, 600) are known from all three boreal continents or from both hemispheres. Two of them (564, *Brothera leana*, and 577, *Entodon drummondii*) are Asian-North American in known distribution. Of those restricted to Asia, 13 are listed by Brotherus as only from Japan (552, 559-562, 569, 576, 580, 581, 584, 586, 588, 590). Geographically, the specimens hail from all of the principal parts of Japan. However, 19 of them, collected by K. Mayebarae, are from Kumamoto Pref., and eight mostly collected by M. Mizutani are from Miyazaki Pref. Nine other collectors contributed specimens from 12 other provinces.

A summary list, alphabetically arranged, of all of the species included in Series 7 to 12 of the *Musci Japonici* was published in no. 19, pp. 119-132, of the Journal of the Hattori Botanical Laboratory. A supplementary list of 27 corrections is appended to the list—Leo Francis Koch

RECENT LITERATURE ON MOSSES

Margaret Fulford[1]

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RECENT LITERATURE ON LICHENS—27[1]

WILLIAM L. CULBERSON[2]

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[BARKHALOV, SH. O.][3] [Lichenological expedition to the Astara and Lenkoran district of the Azerbaidzhan SSR in the year 1947.] [Trudy Inst. Bot. Akad. Nauk Azerbaidzhan SSR] 15: 109-116. 1950. [Many spp.]

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[1] Names of new taxa from the Americas are marked with an asterisk (*).

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[3] Names and titles transliterated and translated respectively from the Russian.

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[LAZAREV, N. V. (Editor of the Medical Sections) & V. P. SAVICZ (Editor of the Botanical Sections).][3] [The New Antibiotic Binan, or the Sodium Salt of Usnic Acid (Botanical and Medical Investigations).] 224 pp. *illus.* [Akademiia Nauk SSSR, Botanicheskii Institut im. V. L. Komarova.] [Moscow-Leningrad.] 1957.—Containing the following papers: pp. 7-29. 5 *fig.* [V. P. SAVICZ.] [Lichens, their use in medicine and the production of the new antibiotic binan.]; pp. 30-49. 10 *fig.* [K. A. RASSADINA.] [On the raw material for the preparation of binan (sodium salt of usnic acid).]; pp. 50-64. 5 *fig.* [E. N. MOISEEVA.] [The sodium salt of usnic acid (the substance binan), its production, physico-chemical properties, and methods of investigation.]; pp. 65-84. 1 *fig.* [M. A. LITVINOV.] [Antimicrobial properties of the sodium salt of usnic acid (the substance binan).]; pp. 85-89. [V. A. BRYZGALOVA.] [Contribution to the study of the antibacterial activity of the substance binan.]; pp. 90-94. [M. A. LITINOV & E. N. MOISEEVA.] [Medicinal forms of the sodium salt of usnic acid (the substance binan).]; pp. 95-107. 2 *tab.* [P. A. IAKIMOV & S. D. SHTEINBOK.] [A new medicinal compound—balsamic solution of binan.]; pp. 108-117. 4 *fig.* 5 *tab.* [E. A. SNEGIREV.] [Contribution to the pharmacology of binan.]; pp. 118-122. [A. D. TROINIKOVA.] [Pharmacological characteristics of binan.]; pp. 123-128. [A. G. GOFREN.] [Report on local applications of binan in surgical dispensary practice.]; pp. 129-133. [E. G. PARKHOMENKO.] [Results of tests on the medicinal properties of binan.]; pp. 134-139. [E. V. KAPATSINSKY.] [On problems concerning the application of the substance binan in surgical practice.]; pp. 140-150. 17 *fig.* 2 *tab.* [A. I. DREVINA & G. K. KORTEGOVA.] [Treatment by applications of binan in penicillin in reactions resulting from the use of metallic bone pins in fractures caused by firearms. (Experimental investigations).]; pp. 151-155. [M. IA. SORO-

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NEWS AND NOTES

Lichenologist RAYMOND DUGHI (Aix-en-Province) has received the 1957 Prix Gandoger, annual award made by the Société Botanique de France for outstanding cryptogamic studies.

In June, ROLAND BESCHEL planned to leave for Europe and go thence to Greenland for a continuation of his studies on lichenometry, a technique which he used earlier in Switzerland to date glacial movements by lichen growth rates.

ARTHUR H. G. ALSTON, distinguished fern taxonomist of the British Museum of Natural History, died recently while on vacation in Spain.

L. J. GIER, William Jewell College, was selected to attend the NSF-sponsored Conference of College Teachers of Biology at Corvallis, Oregon, June 30-Aug. 8.

RICHARD A. STUDHALTER, 70, died March 28. The first head of the department of botany at Texas Technological College, he was well known for his work on *Riella* and *Ephedra*, as well as his investigations on tree rings.

WILLIAM REESE has been granted funds from the National Science Foundation for a continuation of his monographic studies on tropical American Calymperaceae.

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THE HEPATIC EXCHANGE

Beginning January 1, 1939, this Exchange has been operated under the same rules as The Moss Exchange. Privileges are available only to members of the American Bryological Society who have paid annual dues of 25c to Dr. Leo F. Koch, Herbarium, 350 Natural Science Bldg., University of Illinois, Urbana, Ill. Only fully determined specimens in packets with complete data will be accepted. It is suggested that there be at least five packets of each species with an extra which will be forwarded to the Curator of Hepatics for the American Bryological Society Hepatic Herbarium. All material for determination should be sent to the Curator of Hepatics, Dr. Margaret Fulford, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

THE MOSS EXCHANGE

As announced in The Bryologist **38**: 100, Sept.-Oct., 1935, there is now an exchange for mosses. This exchange is available to members of the American Bryological Society upon payment of annual dues of 25c to Dr. E. H. Ketchledge, Dept of Forest Botany, State College of Forestry, Syracuse 10, New York. Only fully identified specimens in packets with complete data on them should be sent in. It is suggested that there be five or more packets of each species.

These two exchanges offer an excellent opportunity for A.B.S. members to build up their own herbaria of choice, well-labelled specimens.